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Engineering News-Record

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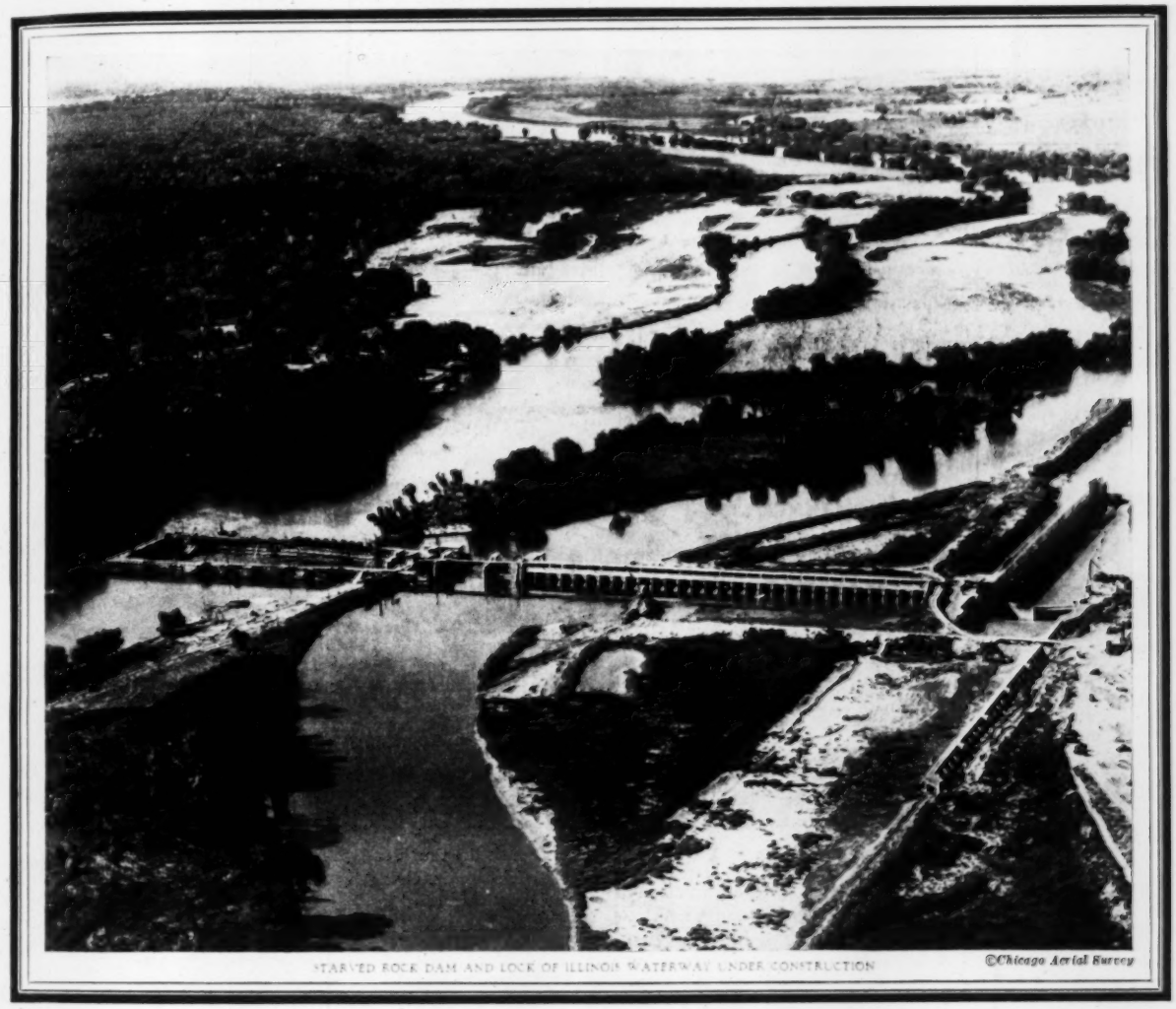

STARVED ROCK DAM AND LOCK OF ILLINOIS WATERWAY UNDER CONSTRUCTION ©Chicago Aerial Survey

Solving Oil-Field Waste Disposal Problems By Co-operative Effort

Blasting Settles Muskeg Fills on Minnesota Roads

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Airport Programs for the Smaller Communities

Sewage Prechlorination at Virginia Beach, Va.

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Building a Lock and Dam on the Illinois River

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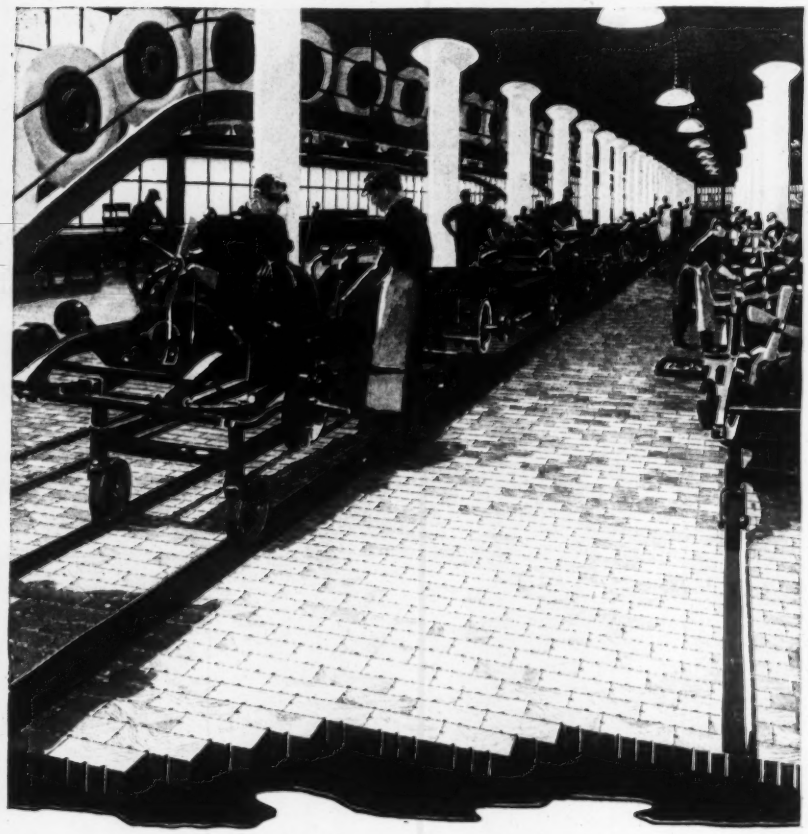

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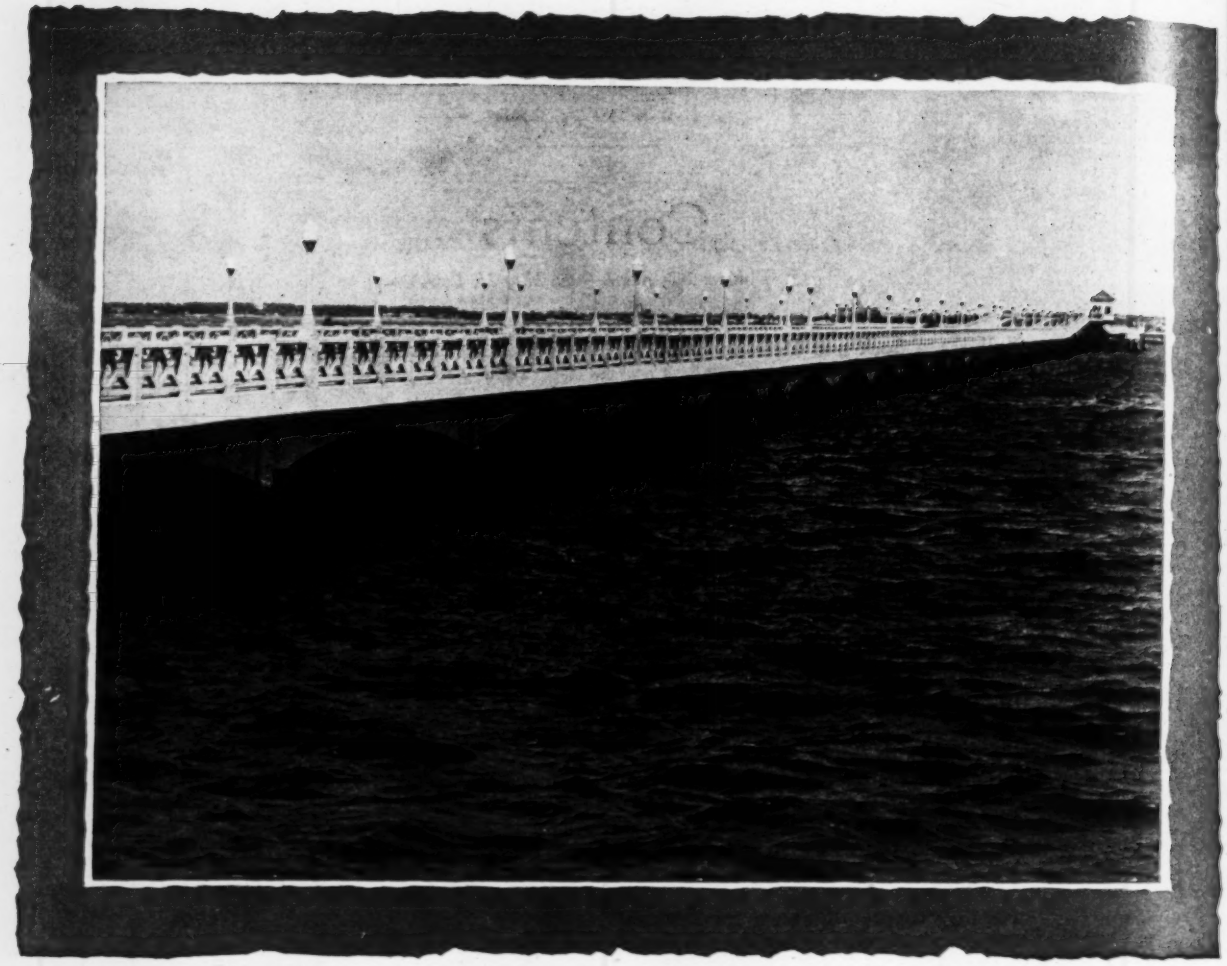

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Outside the Law

THE lack of a serious attempt to enforce the engineers' license law in most of the 25 states where such laws are now in effect was commented upon in these pages recently. We urged that such a law would better not be on the statute books at all if it is allowed to become a dead letter. But another phase of the situation also demands notice. The prevalent lack of aggressive enforcement has brought about a condition which has been overlooked by many engineers now practising without a license. Whether they approve of the law or not, the fact remains that if such a law is on the statute books of the state wherein they practise, they violate it every day that they work. When the time comes that they do apply for a license—for there is no doubt but that they must do so eventually—they will be put in the embarrassing position of acknowledging that they have knowingly violated the license law for years. Moreover, these same engineers are laying themselves open to serious difficulties in law courts in the event that they become involved in lawsuits over structures which they have designed or come before the court as expert witness. No shrewd lawyer would overlook the fact that the engineer on the stand was practising or had practised engineering illegally. These are matters deserving the thoughtful consideration of engineers who still look upon an engineering license as something to be taken or left at their option.

Joint Struts

AN INTERESTING variant of the joint-strut problem in laying concrete pavements is furnished by recent studies of the concrete roads of Maricopa County, Arizona. These roads were famous about 1920 for their extent, the large-scale use of equipment in their construction and particularly for their use for the first time extensively of a thickened-edge slab section. They were built with 1½-in. expansion joints about 250 ft. apart. Cores taken at the joints disclose that their effective thickness is scarcely half their nominal thickness due to intrusion of pieces of coarse aggregate into the joint space. Either in the finishing process or in some other placing operation it is assumed that the aggregate was tamped hard enough partly to penetrate the molded sheets of asphalt-composition joint filler. Whatever the cause the result in many places was the creation of incipient joint struts. This possibility is worth keeping in mind. Though a small fault, a joint strut can cause much trouble and it is a fault that easily occurs in construction and is easily overlooked in inspection. A premolded joint not set so as everywhere to hug the subgrade, or having its two or more sections not closely butted, or cut a little short so as to leave spaces where it ends up against the side forms, leaves ready openings for the molding of joint struts. Few operations in placing pavement slab involve more uncertainty of accurate workmanship than placing expansion joints. To the contractor joint construction is a nuisance under the best conditions. The discoveries in Maricopa County, which were reported briefly last week, are wholly worth while if they focus attention even to a small degree upon practice and hazards in constructing pavement joints.

The Rising Base Level

FROM time to time events lay emphasis on the improvement of efficiency in engineering fields as well as in others. Not long ago we commented on the evidence of progress in construction efficiency, and some time previously on the increased quality of engineering thought and design. Such observations, however, may lead to a mistaken appraisal of the situation if we do not keep in view also the simultaneous advance of all other human activities, particularly those of manufacture and similar productive effort. Each day sees some new advance in human productive ability; a better result is achieved with the same effort, or less effort is required for the old result. Thus manufacturing, transportation and all other elements of our material existence are moving forward constantly to a higher base level of performance. This being so, it is obviously necessary that the engineering arts make similar progress, in order to hold their position in the general line of onward march. Were they merely to maintain the efficiency of yesterday or of last year, they would be losing ground, for an art can no more stand still than can the individual—it must progress or it will go backward. It follows that the effective progress of the profession or of its arts is to be measured not by the standards of yesterday but by the ever higher day-to-day standard which is set by general human progress. In other words, engineering construction forges ahead only as its performance rises in advance of the steadily rising base level of creative production.

Clear the Approaches

WITH traffic congestion a major problem in all large cities, vehicular tubes and bridges are being proposed and built at a rapid rate. These projects are undertaken for the sole purpose of speeding up traffic or in some way relieving traffic congestion and thus their traffic capacity is in large degree a measure of their usefulness. Once a vehicle is on the roadway over which it can continue without interference through the tube or across the bridge, the speed of travel is limited only by the slowest vehicle in the stream. In the approaches, on the other hand, particularly at some distance from the structure, interferences and delays are so much more probable that approaches should be regarded as a major menace in limiting the capacity of the structure. For example, an arterial stop close to the end of a bridge which necessitates a full stop by every vehicle leaving the structure, will decrease the capacity to a very serious extent. It is notable that at 30 m.p.h. and with the spacing between vehicles that is practicable at that speed in open highway travel, a continuous flow of single-lane

traffic will move automobiles past a given point at a rate far in excess of the maximum rate of one-way movement through recent bridge and tube projects. Sharp turns, steep grades, necessity for handling cross traffic, and all other hindrances to the speediest possible movement of traffic that may occur in the approaches to tube or bridge are potential dangers that may prevent the structure from reaching the expected capacity. The study of multiple-lane approaches, grade separation near the structure and in short, whatever expedients will facilitate getting traffic onto the thoroughfare roadway so that its maximum capacity may be attained, are not so much essential elements of the design as they are necessary preliminaries thereto.

Wind and Tall Building Frames

WITH the advent of a new height range of tall office buildings the importance of lateral strength and stiffness is increased so greatly as to direct insistent attention to the uncrystallized state of engineering practice in wind-stress calculation. The 400-foot-high building of several years ago could safely and economically follow conventional methods, especially since the progressive evolution of design up to this range supplied a practical verification of the results obtained with these methods. Today several of our major cities have one or more new structures topping 500 ft., and individual projects will rise to 800 ft. and more, and as this abrupt increase of height is not accompanied by corresponding increase in horizontal area, wind forces become the dominating factors in design.

Questions of economy as well as of safety are at issue. Differences of engineering judgment in proportioning these great structures have been known to occur, and it can hardly be assumed that each of the design methods involved succeeds in utilizing the material with greatest economy. Moreover, aside from strength, it is necessary that solidity or stiffness receive careful attention, since more than one slender structure of recent years has been found by its occupants to be unquiet in gusty and stormy weather, sometimes disturbingly so.

Little has yet been done toward studying these several conditions on the broadly co-operative basis that would seem to be called for by the situation. On the contrary, there is a tendency to make the subject a closely guarded personal matter, and to treat methods of design and proportioning as the engineer's stock-in-trade, to be kept from the knowledge of others. It is difficult to see how such an individualistic attitude can be compatible with professional principle. No engineering method that cannot stand the light of day is adequate for assured public safety. Is it not time that thorough co-operative study of the subject be initiated?

First of the unsettled questions in the case is the actual greatest wind force, and the variability of this force as it may act upon a great building. The field of study here is large and of extreme difficulty. In structures of normal proportions where the safety margin of wind stress remains fairly large, experience shows that the currently used pressure values of 20 to 30 pounds per square foot on large areas lead to safe designing; but in the more extreme proportions the percentage of wind stress may become large enough to leave less ample reserve for possible excess over these pressures—an event that may be rare but is none the less critical in importance. We need more definite knowledge of wind action if building heights are to grow further—or indeed if the new heights of today are to become common. In this field of mammoth dimensions the engineer may no longer content himself with building-code specifications of wind force as sufficient data for his design; his task is to design a building, not to solve the paper problem of satisfying the building code. A great building must endure in any possible eventuality.

Quite as great perplexities beset the calculation of wind-force distribution through the frame. Strict theory is inapplicable, for the combination of steel frame with masonry floors and walls defies assumptions and analyses of groups of elastic rectangles. Wall participation unquestionably is a prime safeguard of current design practices, but for that very reason it calls for a rational appraisal of the relative functions of wall and frame, in order that full justice may be done to both in determining their details. The floors distribute horizontal forces most effectively, as was demonstrated in the Miami hurricane of 1926, but how far this function demands recognition in floor design is still unanswered. Whether the bending resistance of the floor slab is great enough to reduce the effect of girder variation in stories of regular column spacing is another open question.

Can shear distribution among the columns be reduced to fixed practice? Do partition walls contribute measurable resistance or stiffness? Is the bending of wall columns similar to that of interior columns? May truss spans and double story heights be treated in the same way as normal construction? Is the relative action of girders and columns the same in the lower stories of high buildings, where massize column sections occur, as in upper stories? Are the accepted connection details sufficiently stiff to cause the frame panel to act as a rigidly connected rectangle? Questions such as these—and there are many—are involved in the formulation of methods of wind design that can enlist general approval and place the building of extreme height on an assured footing.

What has been accomplished in the planning of the earliest examples of the new generation of high buildings is entitled to all confidence. They will stand a monument to the boldness and the sound judgment of their designers, who, working on the experiences of lower heights, applied their knowledge to good effect. But progress will require refinement of practice and a surer basis than that now afforded. For this reason a comprehensive study of wind-resistance is first on the list of current structural problems.

Industrial Wastes Enter a New Era

THAT industrial wastes should not be dumped into the nearest stream to the detriment of users and riparian owners below is at last finding acceptance by the waste producers themselves. They have been slow in taking the burden upon themselves, but this fact is chargeable in large part to the backwardness of both cities and states in guarding the interests of the public through adequate measures of control. The reason for both cities and states being so laggard in the prevention of stream pollution by industrial wastes is not hard to find: Industry is the life of cities and states alike. It has taken a long time for both, and longer still for the industries, to see that stream pollution is a matter of vital concern to all.

It is to the credit of a number of great industries of the country that they now see the menace to themselves

and to the public of uncontrolled discharge of process wastes into the nearest brook, river, pond or lake. Their own vision deserves much credit for this, but many of them were awakened to their evil practices only by litigation for damages, threatened state legislation and the urgings of state health boards, fish and other conservation commissions. Friendly warnings and offers of co-operative investigations of pollution problems have perhaps done more than any other one thing to change the attitude of the producers of trade wastes from obstruction to co-operation. Self-interest has contributed to the change, both through recognition of the fact that pollution control may often pay a large part of its way through salvaging the wastes that create so much damage downstream and through the realization that upstream pollution was causing them damage, and that the stream as a whole must be cleaned up.

Notable current examples of co-operation between industries and state health and conservation departments can be found in studies of canning, pulp and paper, and tannery wastes during the past few years, some as nation-wide as the industries themselves. Again, the coke and steel industries have joined hand with the state authorities throughout the Ohio River and Great Lakes basins in control of tastes and odors in chlorinated water supplies due to phenol wastes from coke and gas plants.

In recent years a new menace, or an old one in a new region, has arisen, namely, oil and salt-water wastes from the oil fields of the southwest. These have ruined public water supplies. They have imperiled crops on irrigated areas. Of the latter danger, a notable instance is afforded by the article elsewhere in this issue telling how a number of California oil companies have spent well toward a million dollars to prevent the ruin of high-value irrigated lands by their waste products, at the same time salvaging oil to such an extent as to give promise of making the disposal plant more than pay its way.

A bugaboo held up by various industries heretofore to defeat measures to compel them to stop ruining the property and amenities of others has been that their plants would be forced out of business by competitors not required to adopt the same measures. Rarely if ever have either the industries or the city or state authorities taken the trouble to figure out the cost of stream-pollution prevention in unit production costs, with due credit for salvage where that is possible.

Some trade wastes, it is true, may properly go into streams, direct or through city sewers; and where some plant treatment is required it need not all be provided instantly. But broadly, the wastes of every industrial plant must be brought under observation with a view to possible control. The degree and speed of the measures will inevitably have to be based on fair consideration of all the interests affected. The resulting costs are a logical charge on the industrial plant, to go into its unit costs and be passed on to the ultimate consumer.

There will be many cases of wastes disposal through city sewerage systems where the industry will meet its due portion of disposal costs either in taxes or else in annual charges for the use of the public sewerage system, including treatment works—a method of raising sewerage funds long practiced in a few communities, slowly growing in use of late and apparently bound to become widespread within a decade or two.

Isolated industries, like the oil wells treated elsewhere in this issue, or the mills and factories springing up in what was but recently open country in the South—thanks to decentralization made possible by the transmission of electric power—must assume the entire burden of their wastes' disposal, with whatever lightening may be possible through salvage and, in some districts, through joint outlet sewers.

In these newer aspects of industrial waste disposal the engineer, both sanitary and chemical, has already pointed the way. Some have done this in their private connection with industry; some as staff members of public health and conservation departments. Although much has been accomplished, as yet the control of pollution from industrial wastes has only a good start. This is true although chemical and engineering studies that have been going on for fifty or seventy-five years. A new engineering, a new chemistry, an awakened public opinion and a more enlightened spirit in the industries of the country, are bringing on a new era in the control of industrial waste pollution.

Bog-Land Embankment Difficulties

BLASTING methods have in a few years changed embankment construction in bog land from a haphazard operation to a determined procedure. For countless years the engineer knew but one practice in making fills through marshes: to fill and again fill, until, in months or sometimes years, the solid materials penetrated through the yielding ground and came to rest on solid bottom. By the aid of blasting this work for the first time becomes determinable in time and volume. The method therefore may justly be considered a true advance in construction engineering.

The process of blasting peat to settle embankment fill which is described in this issue has been worked out to high refinement in technique and equipment. In much soft-ground embankment work more simple methods will suffice. Moreover, it may often be that in shallow marsh other methods will be more economical than blasting. It begins to be highly efficient where the peat or muck beds are 6 to 10 ft. deep, and in greater depths than 10 ft. it has no rival.

An outstanding lesson of peat-marsh studies is that thorough subsurface explorations should precede filling operations. Many surveys by V. R. Burton, of the Michigan highway department, have disclosed that marsh bottems often have ridges and valleys which if known in advance permit advantageous changes in alignment, not only economizing in volume of embankment but also enabling the line of fill to be kept off slopes that might cause sideslips. In brief, a marsh embankment is not a fill to be dropped down wherever occasion makes it convenient, but is a designed structure fitting chosen conditions determined by engineering methods.

Altogether the peat-marsh studies which highway engineers have had to make in recent years are a significant reflection of the possibilities of engineering research in seemingly unprofitable fields. Constructors of marsh crossings have long continued to follow precedent without rebelling against its soundness. Except for the work of the soil economist the physical characteristics of peat-marsh, muskeg, bog and sinkhole have had scant attention. These recognized obstacles in railway and road construction have been avoided when they could be and struggled across when they must be, by dogged persistence witnout invention. Now that the building of marsh fills is brought nearer to the definiteness of other earth-moving operation, the accomplishment is seen to be an example of the value of questioning construction precedent wherever practice fails of full satisfaction.

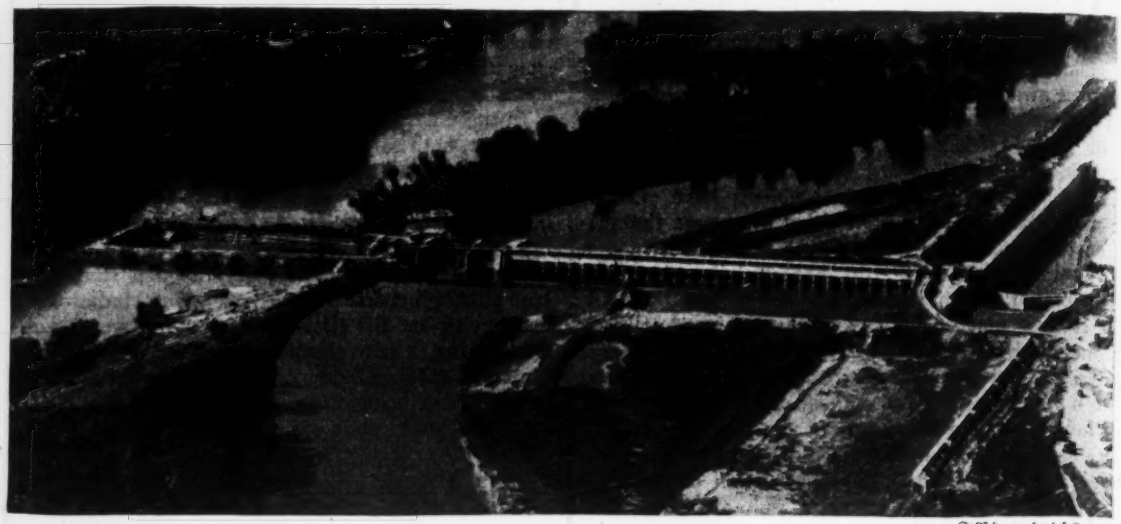

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FIG. 1—STARVED ROCK DAM AND LOCK, ILLINOIS RIVER
View looking downstream. Lock at right; approach channel not excavated. Then headgate structure for future power house. At left, cofferdam for first part of spillway dam.

Building a Lock and Dam on the Illinois River

Lock for Barge Navigation—Dam Has Stoney Head Gates, Trash Gate and Tainter Gates on Spillway—Construction Methods and Plant—Traveling Forms Used—Blasting Practice

By Sutton Van Pelt
Supt. of Construction, Woods Brothers Construction Company
Lincoln, Neb.

The Starved Rock lock and dam is the third to be completed of five similar structures being built to provide slack-water navigation from the Chicago Drainage Canal down the Des Plaines and the Illinois rivers to the Mississippi. One other lock and dam is under construction, two others have been completed and the fifth is not yet begun. Contracts have been let for approach canals to the locks and for various works of channel deepening. The waterway is planned to give an 8-ft. channel for 9,000-ton barges with 14 ft. of water over lock sills and 110x600-ft. lock chambers. In 63 miles the fall is 140 ft. of which 126 ft. has to be overcome by locks. The work was authorized in 1908, when a bond issue of $20,000,000 was voted; legislation empowering construction was enacted in 1919. The contract for the first lock was let in December, 1920. The waterway is being constructed by the State of Illinois.—Editor.

FIVE LOCKS 110x600 ft. are required in the 63-mile Illinois Waterway, which is to connect the Chicago Drainage Canal with the Illinois River. Some of these structures have been described in *Engineering News-Record*, and so far as lock features are concerned the Starved Rock lock, near La Salle, Ill., does not differ much from the others. But the headgates, ice chute and spillway dam with tainter gates are novel features. The headgate structure and the tainter gates will raise the upper pool ordinarily about 16 ft. above the downstream level. An airplane view of the work, looking downstream, is shown in Fig. 1. At the right is the lock, with approach channel cleared but not excavated. Adjacent to it is the headgate structure for the future power house. The waterway opening is for the ice chute, and to the left of this is the cofferdam for the first part of the spillway dam. Downstream from this is the high cliff known as Lovers Leap, a part of the lofty Starved Rock.

This lock is the lowest of the series and joins the channel of the Illinois River, the improvement of which is under the supervision of the federal government. This channel has a fall of only 35 ft. in 233 miles. The pool above the lock will provide a 9 ft. channel to the foot of the next lock, at Marseilles, Ill. The Starved Rock dam and lock structure are built on limestone rock which is found about 20 ft. below the surface of the overlying sand and shale rock layers. The surface of the rock is very uneven, as are the various layers of sand and shale, but the latter gradually become horizontal toward the top surface. Fig. 2 is a general plan, which shows also the layout of the cofferdams and construction plant. Fig. 3 is a plan of the dam.

Headgate Structure—This part of the dam, extending from the river wall of the lock, opposite the upper gates, is 566 ft. long, 33 ft. wide at the base and varies in height from 32 to 45 ft. above the foundations. It consists of 30 gate openings 14 ft. wide between piers usually 3 ft. wide (Figs. 3 and 4). The piers are surmounted with heavy slabs of concrete to make them stable against movement before the power-house structure is erected. These piers will support the trash racks and also house the Stoney sluice gates, of which there will be two to each opening, one above the other (Fig. 4). These gates will remain lowered to form a dam until the power plant is built. This plant ultimately will generate about 15,000 hp., if the present diversion from Lake Michigan is maintained, but the date of its construction is uncertain.

Ice Chute—Adjoining the river end of the headgate structure is a 30-ft. chute for passing ice and trash which may collect in front of the headgates. On its masonry spillway is to be mounted a steel sector drum revolving on its horizontal axis and in a recess provided in the masonry, as shown in the cross-section, Fig. 4. The level of the drum will be controlled hydraulically. Water will flow in through a tunnel in the bottom of the ice chute pier, then through a 30-in. gate valve and rise through a 30-in. tube into the recess under the drum. From there the water will pass upward through a series of tubes into the recess and against the drum.

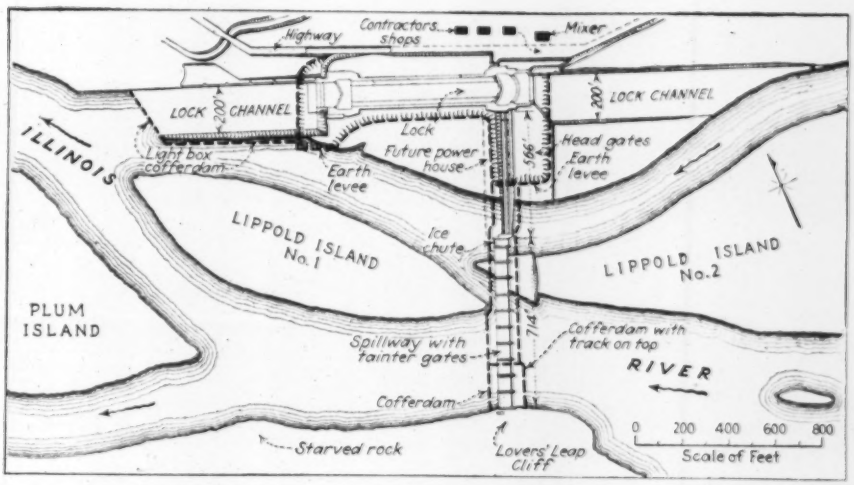

FIG. 2—LOCK AND DAM, SHOWING CONSTRUCTION WORKS

Water will also pass from the tunnel through another 30-in. tube beyond the gate valve to a vertical weir tube suspended on a vertical screw shaft with hand wheel by means of which the tube can be raised or lowered to raise or lower the drum correspondingly. When the drum is level with the upper pool, no water passes over the weir, the drum standing at its highest position. If water passes over the tube, the drum will assume a lower position. Water passing over the drum escapes through a 30-in. tube to the river below the dam. Valves provide for shutting off the water for inspection of the drum.

Tainter Gates—Between the ice chute and the left riverbank, a distance of 714 ft., the dam will have ten tainter gate openings 60 ft. wide, with piers 8 ft. thick and about 50 ft. high, the height depending on the depth to sound rock. These openings will provide for a depth of 17 ft. of water over the gate sills. The gates (Figs. 3 and 4) will be of steel, counterbalanced and equipped for both hand and motor operation. A foot bridge will span the openings between piers for access to all the gates. A system of heating pipes will be installed for warming the contacts between the gates, piers and sills, so that ice troubles can be avoided in winter. These gates are to regulate the pool levels, being raised to pass floodwaters and lowered during dry periods to maintain the pool level.

Construction Methods—This structure is being built in four sections (see Fig. 2.) The first section, including half the lock and the headgates, was on land and was surrounded with earth levees to protect it during the seasons of high water always to be expected.

The next section included the second half of the headgates and three piers in the spillway dam. Its cofferdam was partly a levee and partly a box cofferdam. The latter, made of 6-in. Wakefield sheet piling tied together with rods and wales, was made with width equal to its height and was filled with earth from borrowpits by dump cars on tracks on the dam. As there was mostly only bare rock on the river bottom, piledriving was not difficult and a simple moving scaffold was used (Fig. 5), having a cross-bar to support piling and pile hammers. The hammers were operated by a 15-hp. gasoline engine on which a spool was rigged to handle the pull lines. The hammers were of hardwood and the leads were 1-in. rods fastened to the pile cap. The whole rig did not cost more than $500, but it could drive from 60 to 80 piles a day.

No trouble was experienced with the cofferdam or levee except that due to frost action. Some water would seep through the rod holes in the piling, but this was not serious. Frost, however, always creates trouble and must be closely watched. One serious leak flooded the site due to a break in the levee when a sudden severe freeze caught it with the unfinished top only 3 ft. above waterline. The top of the bank froze and the rising water settled the unfrozen earth below it at the waterline, causing a leak which filled the inclosure in less than an hour. Another leak which caused some trouble occurred at a corner in the dam, where seepage started along several tie rods and washed out a large hole where the rods converge at the inside angle of the dam. The top of the fill was frozen and did not drop down to fill the hole.

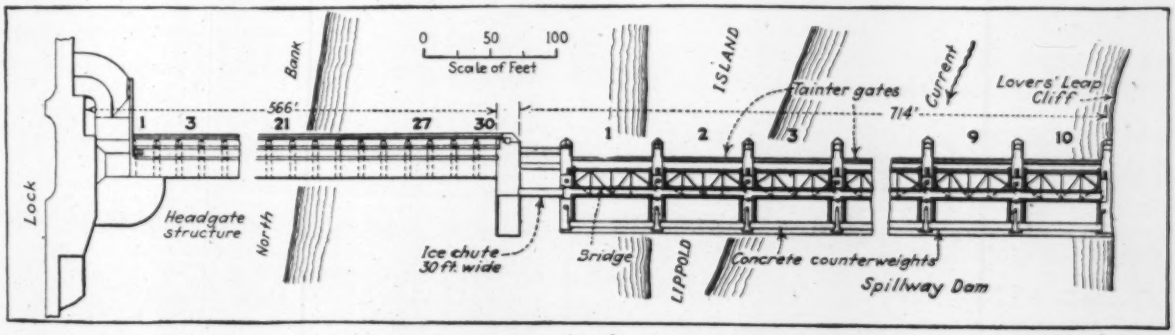

FIG. 3—PART PLAN OF STARVED ROCK DAM

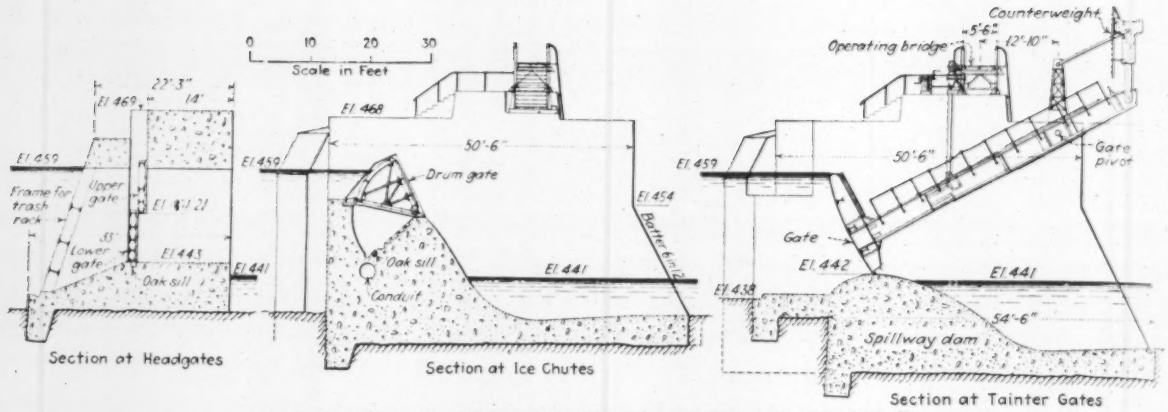

FIG. 4—SECTIONS AT HEADGATES, ICE CHUTE AND SPILLWAY

During cold weather a system of patrol was maintained. Post holes were sunk deep on the center line of the dam to watch for saturation, seepage and settlement in the under soil. This section of dam blocked more than half of the cross-section of the river channel, but no bad results came from it during flood times, the ice and water merely flowing a little faster. There was ordinarily a difference in water level of 0.2 to 0.3 ft. between the upper and lower sides of the dam.

The third section (Fig. 6) was built out from the island 300 ft., leaving only 200 ft. of open channel between it and the left bank. The upper side was built of alternate sections of crib and box coffer, because this work could be done best in flowing water. The lower side and the end were all box dam in still water. Cribs of 6x8-in. timbers, fastened with $\frac{5}{8}$-in. drift bolts, were built of equal width and height. They make a stiffer structure than a box dam but are not as watertight. Filling, especially above the waterline at time of placing, will not pack tightly around the timbers and will give more or less trouble when the river rises. When this section was being built, the channel was reduced from 800 ft. to a little less than 300 ft. without causing any trouble. There was ordinarily a difference in level of 0.7 ft. just above and below, but at maximum flood stage the difference was 2 ft.

At the outer downstream corner of the cofferdam shown in Fig. 6, a port hole was left for passing heavy equipment brought on barges, thus saving raising it over the dam. This opening could be closed when high water came and could also be used as a sluiceway to rewater the site if the river became too high.

As the third section was being built, the second section was being torn out to widen the river channel and to provide material. Work inside section 3 is practically completed. Section 4, the end of the dam is being built this spring, and the whole job will probably be completed by July, 1929.

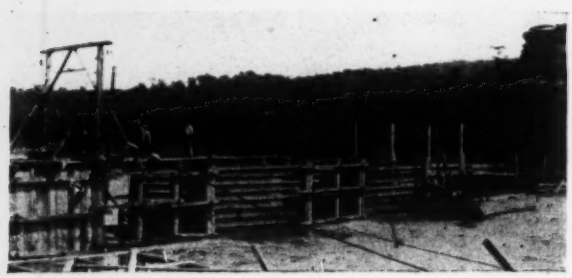

FIG. 5—PILEDRIVER RIG FOR COFERDAM
Cliff of Starved Rock at right.

Concreting—In the concrete operations there were no special innovations, but probably the most interesting feature was the delivery of concrete from cars into forms. Cement and bank-run gravel were elevated direct from cars to bins above the mixer, the gravel being handled by a derrick with 80-ft. boom and $1\frac{1}{4}$-yd. clamshell bucket.

FIG. 6—COFFERDAM AND OPERATIONS ON SECTION 3
View looking upstream. Forms for ogee spillway suspended from two groups of timber trusses. Concreting train at right.

As the sources of supply were close at hand, it was cheaper to pay for demurrage than for storage. A gravel batcher and cement weigher measured the materials for a 1-yd. drum mixer operated by a gasoline engine. The mixer discharged concrete into 2-yd. steel hopper cars having side-discharge radial gates. These cars were moved over tracks of 2-ft. gage by 6-ton gasoline locomotives in 2-, 3- and 4-car trains, according to conditions. Fig. 7 shows a train delivering concrete at a chute. The haul varied from 100 to 1,800 ft. Two and three trains were used, to make the movement as steady as possible. This outfit could mix and deliver 500 cu.yd. in ten hours, but the output was limited by the places available for depositing concrete. It was reasonably possible to mix and deliver over 15,000 cu.yd. per month, and during our good working months the output was around 12,000 cu.yd.

For the irregular-shaped blocks of the lock, paneled wood forms were used as far as possible. For the uniform wall blocks, there were two traveling steel forms that would inclose blocks 30 ft. long and 38 ft. high. The formwork at the lock is shown in Fig. 8. When one side of the lock was completed, these forms were

moved across to the other side by using rollers and cribbing, as in house-moving operations. This method saved time and money as compared with dismantling and re-erecting the forms. Concrete was delivered by cars running on top of the cofferdam, which was level with the top of walls, and was poured direct into gravity chutes for those levels which could be reached by a 1 on 3 slope. The remainder was elevated and conveyed on a 30-in. belt conveyor. Panel wood forms were used wherever possible on the headgates and dam structures.

Traveling wood forms were used for the tops of headgate base and the spillway of the dam. Two sets of each kind were used. A set consisted of four wood trusses (see Fig. 6) made of 2x6-in. planks well nailed together, the trusses having lateral and wind bracing to make them

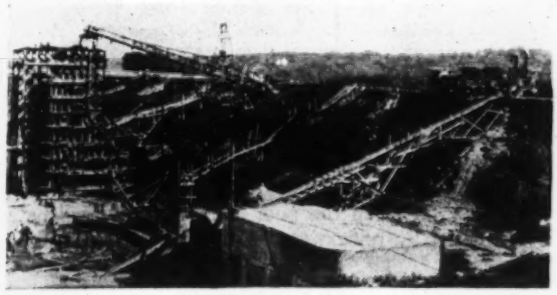

FIG. 7—METHODS OF PLACING CONCRETE
Bottom-dump cars deliver concrete into gravity chutes or into hoppers feeding belt conveyors.

rigid as a whole. Each set was mounted on pairs of double-flanged wheels rolling on single rails, one on each side of the hole to be concreted. The forms which were to shape the top of the concrete were suspended from the trusses by rods having turnbuckles for adjusting the forms to position. These forms were 20 ft. wide and as long as the block, 30 to 55 ft., the truss spans being 35 and 60 ft. respectively.

Concrete for this part of the work was delivered from the cars either direct into gravity chutes or into large intermediate hoppers which fed it to the conveyor or the monkey stick tower (see Fig. 7). Cars could discharge concrete faster than the belt or tower could take it, and the hopper served as an equalizer to maintain an even flow from the mixer to place. The cars moved over the top of the cofferdam 20 ft. above the bottom. On this bottom was a 12-ft. gage track for a gravity chute, belt conveyor and tower, each moving on its own wheels. This chute connected with a similar chute built in the movable forms. Chuting was used wherever concrete in the aprons, spillways and piers could be placed by gravity. The conveyor was used to fill the piers above gravity placing and below the top lifts, for which last the tower was used. This plan was very flexible. It permitted more formwork to go ahead at a time and also speeded up the concreting by having plenty of places to pour.

The ice chute and pier required special treatment, being full of pipes, tubes, recesses and stairways. All forms for them were made on the platform and in parts so they could be assembled like toy blocks. This was the cheapest and best way. Although the pier was 18 ft. wide and 40 ft. high above the footing, no external bracing or guy lines were used, but it was poured the full height as a monolith and with good results. Its volume being large, concrete could be poured rapidly but did not build up in height rapidly.

Telescopic pipe chutes or "elephant trunks" and special chutes were avoided as far as possible, concrete being allowed to drop 20 ft. or more. This saved time and expense and much unnecessary labor and secured good results. No special mixtures were used to get dense and impervious concrete, but only a good standard mix, wet enough to flow well and be workable. On the dam a cableway was improvised for setting and delivering concrete and steel and for placing and pulling forms for the piers. A small gasoline hoist mounted on a hand car which could move along the cofferdam was used to do this hoisting and also to hoist concrete for the tower, to lift muck and to clean up stuff from the bottom of the hole, and to set and pull panel forms low down in the hole. For this low-down work other cables were stretched over the hole and made fast to the top of the cofferdam on each side.

Excavation and Blasting—In excavating for the lock and its approaches, gasoline draglines and shovels were used, loading the muck into 5-yd. dump cars which were usually hauled to the dump in six- to eight-car trains by 12-ton gasoline locomotives on tracks of 3 ft. gage. After

FIG. 8—CONCRETING THE LOCK, 110x600 FT.
At left, steel forms for lock walls and wood form for 12-ft. conduit where it changes grade and line to pass around recesses for lock gates. Belt conveyor for concreting conduit. Wood forms in foreground for enlarged ends of lock walls.

removing the earth, the rock was drilled both for line drilling and blasting. Excavation for the dam structures was principally rock. The cuts were narrow, deep and long. The sides had to be line drilled to get vertical

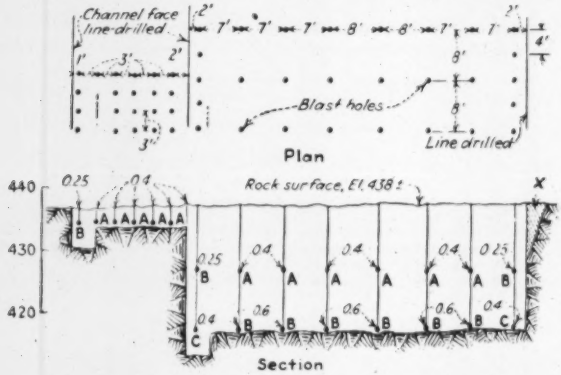

FIG. 9—BLASTING FOR FOUNDATION OF SPILLWAY
Dots on section indicate location of charges. No delay detonator caps used at *A*. First delay caps at *B*. Second delay caps at *C*. Fractions indicate pounds of dynamite per cubic yard of rock. When delay caps were not used, the rock outside the drilling line, at *X*, is likely to spall off. Delay caps and varying amounts of dynamite were used to get an equal crushing power on the rock.

faces and save waste in cross-section. Line-drill holes were spaced 4 to 12 in. apart, depending upon conditions. Shot holes were spaced 6 to 8 ft. apart and closer near the walls. All drill holes were 18 to 20 ft. deep. An average of ½ lb. of 40 per cent dynamite was used per yard of rock, but it was loaded lighter or heavier according to its position in the cut, being light near the sides to prevent shattering the faces and heavy in the middle and bottom of the cut where plenty of force was needed.

Delay caps to assist in getting the mass of rock to break right were arranged as shown in Fig. 9. The depth of face was 20 ft. Loads were concentrated at the bottom of each hole and half-way up. First-delay caps were used half-way up in the holes adjacent to the sides, also in the bottoms of holes not adjacent to the sides. Second delays were used in the bottoms of holes adjacent to the sides. By varying the powder charge and using delays, the muck was finely broken and there was very little shattering of the faces. Possibly some powder might have been saved, but there was considerably less hand mucking, block holing and lost machine time to compensate for it. Modern percussion drills were used, mounted on frames which could be easily moved by two men. An average day's good work was 500 lin.ft. or more. A gasoline dragline loaded the muck from the hole into dump cars on the cofferdam, with an extreme lift of 50 ft.

Engineers and Contractors—These structures were designed by Walter M. Smith, chief designing engineer, under the direction of M. G. Barnes, then chief engineer of the State Division of Waterways, who was succeeded by L. D. Cornish, the present chief engineer. J. B. Bassett is the division engineer and C. R. Andres is resident engineer in charge of the work.

Excavation for the lock and its approaches was done under sub-contract by Wilson & Company, Ottawa, Ill. Steel for the lock gates and tainter gates will be fabricated and erected this year by the Independent Bridge Company, Pittsburgh, Pa., of which P. E. Hunter is general manager, with P. A. Smith as field superintendent. The general contractor is the Woods Brothers Construction Company, Lincoln, Neb., with Wayne Pringle, chief engineer; G. K. Leonard, general superintendent, and the writer as superintendent of construction. The writer, while in the employ of the State Division of Waterways, wrote the specifications and contract for the work and it is now his pleasure to have the engineers tell him what the specifications mean. This job is remarkable for the small amount of expensive plant used. Much of the plant was improvised on the job, and was assembled and altered to fit conditions which were frequently changing. The costs of the work have been satisfactory. The working force varied from 100 to 300 men.

Underwater Lighting of Swimming Pools

By E. W. Beggs
Commercial Engineering Department, Westinghouse Lamp Company

BECAUSE of its many appeals the lighting of swimming pools from lights placed beneath the surface of the water has grown in popularity. An all-illuminated pool is also a safe pool, since every swimmer is continuously in the sight of lifeguards, spectators and other swimmers, even when the pool is crowded. Hygiene is also promoted by underwater lighting because it shows

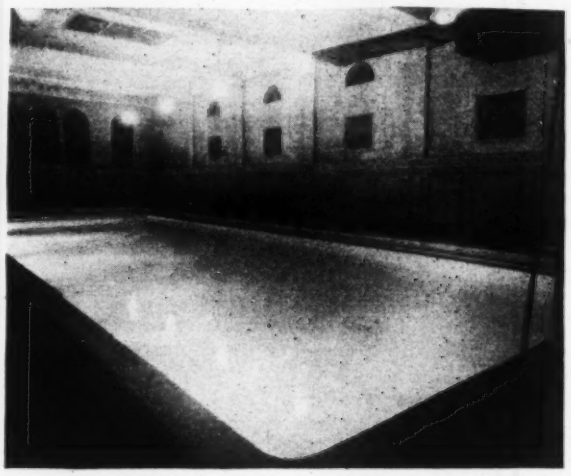

FIG. 1—OVERHEAD AND UNDERWATER LIGHTING OF SWIMMING POOL

up clearly any defects in the performance of filters or want of cleanliness in floor or walls.

A general plan for underwater lighting suitable for the average pool together with installation details is shown in Figs. 2 and 3. The best number and arrangement of fixtures will vary with conditions, but for good lighting

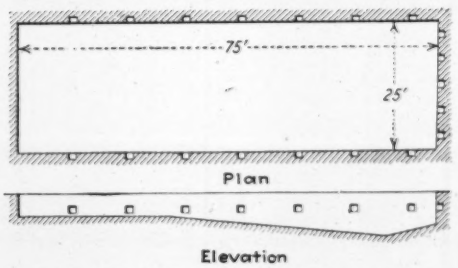

FIG. 2—TYPICAL ARRANGEMENT OF FIXTURES IN STANDARD SWIMMING POOL

approximately 30 generated lumens per square foot of pool surface should be maintained. Sometimes, as in the case of the pool illustrated in Fig. 1, where the gallery is located entirely on one side, all fixtures may be mounted

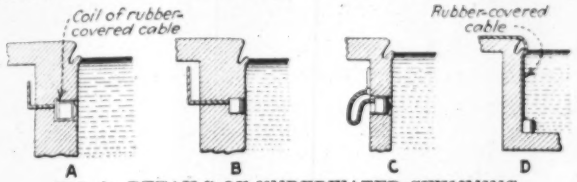

FIG. 3—DETAILS OF UNDERWATER SWIMMING POOL LIGHTING

A—Projector in recess—for pools inconvenient to drain, particularly where built in the ground. Fixture can be drawn to surface for attention. *B*—Projector cast in concrete—for pools easily drained below level of fixtures for service. *C*—Projector behind glass plate—fixture to be serviced from behind wall. *D*—Projector on pool floor—for temporary underwater lighting.

in that wall. A variety of effects may be obtained by using diffusing, refracting or colored lenses. A special floodlighting projector for use in these installations occupies a space $8\frac{7}{8}$ in. square and $8\frac{3}{4}$ in. deep. It can be supplied with 100- or 400-watt lamps.

Sewage Prechlorination Successful at Virginia Beach, Va.

Odor From Septic Tanks Controlled by Application of Chlorination to Raw Sewage Before It Reaches Tanks

By William W. Watkins
Chief Chemist, Bureau of Water, Norfolk, Va.

CONTINUOUS prechlorination of crude sewage at the pumping station ahead of septic tanks at Virginia Beach, Va., was practiced during the summer of 1928. No attempts were made to secure other than a crude control of the chlorine dosage such as might be expected at plants of this character. Elimination of a serious odor nuisance was obtained and, simultaneously, it was shown that prechlorination alone, when practiced in connection with septic tank treatment, may be relied upon to produce a tank effluent containing no colon bacilli in 1-c.c. portions.

Experimental partitioning of the total chlorine applied between the crude sewage ahead of the tanks and the tank effluent—that is, "split-chlorination"—has been tried. In either instance, to insure high-grade disinfection residual chlorine in the tank discharge is practically essential and "split chlorination" at this small plant does not appear to possess any material advantage over prechlorination alone. There appeared certain disadvantages which warrant the preference for prechlorination alone at Virginia Beach. Prechlorination likewise possesses distinct merits over postchlorination alone.

The plant at Virginia Beach, as originally designed, consisted of three hopper-bottom tanks, each 56x12x8 ft. deep, designed to be used in rotation as settling-digestion tanks. Chlorine was applied to the effluent, which was thereafter passed through a baffled contact chamber of 30-minute detention capacity. The rapid growth of the town in 1925 and 1926 made it necessary to operate the plant as three septic tanks in parallel. Because of the serious odor nuisances created, it was decided in the late fall of 1927 to operate the east and west tanks alternately and to transfer the sludge to the center tank for digestion. Prechlorination was commenced prior to this change in operation, during which time its merits in connection with control of odors from dirty septic tanks was first demonstrated. Thereafter the change was made and prechlorination continued.

All the sewage from the south end and part of it from the north end of the town is collected in a large sump and lifted by an automatic pump to a gravity sewer, which delivers to a suction well, from which the sewage is pumped about $\frac{1}{4}$ mile to the septic tanks. The tank effluent discharges into a tidal estuary, which is to all practical purposes a stagnant body of water. In consequence the odor nuisance was accentuated. The tanks are located about 500 yd. from a state highway which passes over the estuary. Just north of the plant is a high-class residential section and the Country Club golf links. South and east, $\frac{1}{2}$ mile distant, is the town of Virginia Beach, and no matter which way the wind blew objectionable odors reached thickly populated territory. There were many complaints in 1926, which increased manyfold in 1927.

In September, 1927, a hydrogen sulphide survey was made which showed that the raw sewage contained from 2 to 4 p.p.m. of hydrogen sulphide and the tank effluent 15 p.p.m., indicating complete breakdown of the sulphates, which are normally 37 p.p.m. (SO_4) in the town water supply. With the results of this survey in hand, a conference was held by A. L. Fales, of Metcalf & Eddy, consulting engineers, Boston; D. S. Calcott, supervising engineer, town of Virginia Beach; L. H. Enslow, research engineer, the Chlorine Institute, Inc., and Richard Messer, chief engineer, State Board of Health of Virginia. It was decided to make a trial of prechlorination. The chlorine was applied through a manually operated vacuum-type machine at the pumping station, located about $\frac{1}{4}$ mile from the disposal tanks. The writer supervised this prechlorination program and conducted the necessary tests.

Results—After trying several different ways of operating the three septic tanks, it was found more effective to operate them singly, thus giving a retention period of three to four hours in which sufficient settling was secured. Insufficient chlorine to produce residual chlorine in the tank effluent was entirely effective in eliminating hydrogen sulphide. The old odor nuisance at a distance greater than 100 yd. from the plant disappeared within a few days following the start of prechlorination. It was also observed that scum did not accumulate so rapidly after prechlorination was started as before. The real criterion in so far as correction of the odor nuisance was concerned is the fact that no complaints were registered during 1928, with perhaps one or two exceptions, when sludge withdrawals were obviously responsible.

Bacterial results proved conclusively that if we were to secure the consistently high efficiency of B. coli removal desired, it was essential that a trace or more of residual chlorine be maintained in the effluent. (See table.) During the summer months a chlorine dosage of approximately 20 p.p.m. seemed to be satisfactory. In cooler weather a proportionately less dosage was required—that is, 10 p.p.m. or thereabouts. Semi-automatic equipment to insure a fairly constant ratio between chlorine applied and the fluctuating volume of flow apparently should prove more economical in chlorine consumption for a desired result and simultaneously insure greater consistency in the results secured.

An observation concerning the chlorine requirement of the crude sewage was of particular interest to the writer. A rate of application of approximately 18 p.p.m. was required to secure residual chlorine to an extent of approximately 1 p.p.m. in the normal day sewage (dry-weather flow) before a storm came up. The rate of flow increased due to leakage into the sewer, and although the chlorine dosage calculated for various periods during the storm flow gradually decreased to 5.5 p.p.m., residual chlorine was maintained in the crude sewage all through the period of storm flow. After the storm the flow gradually dropped back to normal and the fixed chlorine rate continued to prove just about that required to insure the desired residual. Thus it has been shown through this experience that chlorine requirement at sewage plants can not be based on volume treated, but instead must be based on strength of the sewage. It appears that the policy of stipulating a chlorine rate based on the population load is more feasible in connection with domestic sewages than other previously accepted factors—for example, parts per million. The observation further indicated the relatively minor importance which storm flow has in affecting sewage prechlorination practice.

PRECHLORINATION RESULTS AT VIRGINIA BEACH, VA.

Date, 1927	Sample	Chlorine Dosage (to Crude), P.P.M.[1]	Resid. Chlorine P.P.M.[2]	H_2S P.P.M.[3]	Degree of Disinfection: Total Bacteria	Degree of Disinfection: B. Coli Per C.C.
Oct. 15	Crude enfluent	None	None	0.5	(Prior to prechlorination)	
	Tank effluent	None	None	15.3		
Nov. 3	Crude (chlorinated)	5.6	0	0.4	350,000	10,000+
	Tank effluent		0	0.8	350,000	10,000+
Nov. 4	Crude	19.0	0.5	0	40,000	0
	Effluent		0	2.3	400,000	1,000
Nov. 5	Crude	18.4	0.5	0	70,000	0
	Effluent		0	0.15	400,000	100
Nov. 16	Crude		0.5	0	300,000	10
	Effluent		0	....	300,000	100
Nov. 22	Crude	25.(?)	1.+	0	850,000	0
	Effluent		0.1	0	120,000	0
Nov. 25	Crude		1.0	....	100,000	1/10
	Effluent		0	....	140,000	10,000
Dec. 9	Crude	9.0	1.+	0	25,000	0
	Effluent		0.5	0	35,000	0
Dec. 14	Crude	10.0	1.0	0	7,000	0
	Effluent		0.2	0	40,000	0
Dec. 21	Crude	9.1	1.+	0	12,000	0
	Effluent		0.2	0	11,000	0
1928						
June 11	Crude	9.5	0	....	2,000	10,000(?)
	Effluent		0	0.1	6,000	10,000(?)
June 13	Crude	14.0	0	2.1	8,000	100
	Effluent		0	1.5	7,000	100
June 19	Crude		0	0.7	18,000	10,000
	Effluent		0	1.0	20,000	1,000
June 22	Crude	12.3	2.0	3.1	9,000	1
	Effluent		0.2	0.0	5,000	0
June 25	Crude	23.7	Tr.	3.5	10,000	10
	Effluent		0.2	0	20,000	1/10
June 29	Crude	18.5	0.5	1.0	5,000	0
	Effluent		1.+	0	2,000	0
July 2	Crude	26.0	2.+	2.2	5,000	10
	Effluent		0.2	0	4,000	0
July 5	Crude	21.2	0	2.7	7,000	10,000
	Effluent		Tr.	0	4,000	1/10
July 14	Crude	15.6	1.+	5.3	4,000	1/10
	Effluent		0.1	0	3,000	1/10
July 16	Crude	20.2	Tr.	3.0	10,000	100
	Effluent		0	1.1	5,000	100
July 24	Crude	22.4	2.0	1.3	6,000	1/10
	Effluent		1.0	0	1,000	1/10
July 27	Crude	15.3	1.0	1.8	8,000	0,000
	Effluent		0	1.2	3,500	10,000(?)
July 31	Crude	21.4	0	4.2	8,000	100
	Effluent		1.0	0	1,000	0
Aug. 3	Crude	20.6	0	3.7	9,500	10,000
	Effluent		0	0.9	3,000	10,000
Aug. 8	Crude	23.5	0	2.1	12,000	10,000
	Effluent		2.+	0	1,000	1/10
Aug. 11	Crude		2.+	2.1	1,800	0
	Effluent		2.+	0	800	0
Aug. 14	Crude	22.6	2.0	2.1	1,600	0
	Effluent		2.+	0	700	0
Aug. 18	Crude	10.4	0	3.2	12,000	10,000
	Effluent		0	0	6,000	10,000
Aug. 21	Crude	18.6	Tr.	1.0	16,000	10,000
	Effluent		0	0.4	2,000	10,000
Aug. 24	Crude	19.2	2.+	2.7	10,000	10,000
	Effluent		2.0	0	2,000	1/10
Aug. 31	Crude	12.2	....	2.0	8,000	10,000
	Effluent		0	0.3	10,000	10,000
Sept. 5	Crude	14.4	2.0	2.2	7,000	1/10
	Effluent		0.1	0	4,000	0
Sept. 10	Crude	16.7	2.+	1.9	16,000	1/10
	Effluent		2.0	0	4,000	0
Sept. 12	Crude	23.2	2.+	0.6	12,000	0
	Effluent		2.0	0	3,000	0

[1]The chlorine dosages represent the average dosage for the day in most instances. The samples taken represent a dosage during some particular part of the day and therefore the lack of conformity between chlorine dosage, residual in effluent and bacterial results on effluent samples. The dosage aimed for was between 18 and 20 p.p.m., which seemed adequate for summer conditions.

[2]Residual chlorine recorded at exact time of sample collection. There are one or two high bacterial results in presence of residual chlorine which is difficult to explain.

[3]Hydrogen sulphide in crude determined on samples collected at point preceding chlorination.

At times the bacterial results were very erratic because of the ever-changing ratio of chlorine to sewage and consequent variation in chlorine dosage when the fixed rate of application was depended upon to produce the results desired. Except for the fact that the tanks themselves with three or more hours of detention acted as balance wheels to modify fluctuations, the results would have been more erratic than was the case. Under circumstances wherein the chlorine dosage could have been automatically controlled the results would have been superior with a lesser chlorine consumption.

Split Chlorination—A second chlorinator was installed for postchlorination in conjunction with prechlorination, but because of the satisfactory odor correction with prechlorination alone at a cost which was not deemed excessive considering the results secured, it was not the wish of the city authorities to experiment with split-chlorination during critical periods. It was therefore necessary to postpone experimentation until the most productive period of nuisance (that is, hydrogen sulphide generation) had passed. Even so, the results secured failed to indicate any real advantage or material economy to be secured by splitting the chlorine dosage between the influent (crude) sewage and the effluent (settled) sewage. Maintaining two chlorinating stations for the purpose, which in the case of Virginia Beach were of necessity ¼ mile apart, created an added problem and increased expense of operation.

During single application at the crude sewage pump station it was necessary for the superintendent of sewers to visit the prechlorination station only once or at most twice a day during the periods of greatest danger of hydrogen sulphide (odor) production. In the case of larger plants it may prove advantageous to employ split chlorination, but certainly not under circumstances existing in most small communities or summer resorts.

The experiments were carried out with the plant operation under the direction of D. S. Calcott, supervising engineer, town of Virginia Beach. Richard Messer, chief engineer, and Herman Snidow, assistant engineer, Virginia State Department of Health, gave assistance and helpful suggestions. L. H. Enslow, research engineer, the Chlorine Institute, gave personal supervision and assistance. The Wallace & Tiernan Company, Inc., loaned the chlorinator used in the split chlorination studies.

Madrid Underground Railway Extended

The Madrid Underground Railway, Spain, has opened an extension of 1.15 miles, making the total length six miles. This extension is built under a main thoroughfare and has three stations. Its maximum grade is 3 per cent. The track is laid with 80-lb. rails, but these are 59 ft. long instead of 36 ft. as on the older part of the line. Their joints also are welded solid, expansion joints being provided at intervals of approximately 1,000 ft.

Airport Programs for the Smaller Communities

An Outline of the Rudiments of Airport Planning and Location for the Guidance of the Small City Engineer

By Donald M. Baker

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AIRPORTS within the past two or three years, since the passage by Congress of the air commerce act, have entered the class of municipal utilities. This is no less true for the smaller community than for the metropolis, but the latter, because of its greater and more urgent demands, has received much the larger share of technical guidance in developing its air-terminal facilities. This article is planned to aid the engineers in the smaller communities in familiarizing themselves with the rudiments of airport location and planning.

Every municipality of around 100,000 population will in the near future, if it does not now, find it necessary to develop an airport as an air-traffic terminal, with possibly additional airports for local purposes. The airport for the smaller community is closely analagous to these additional airports and its various probable uses may be grouped as follows: by local owners of planes for landing, takeoff and storage; for way stops by through transport lines; for landing, takeoff and storage of private and taxi planes not locally owned; and by sightseeing planes. Such uses can be accomodated on a much smaller site than is needed for an air-traffic terminal, and the sites do not require the equipment or construction costs necessary on the larger ports.

After an airport program has been determined upon by the community the following steps are necessary: (1) selection of the body which will be responsible for putting the program across; (2) determination of proper legal authority under which the airport may be acquired, improved and operated; (3) selection of a proper site or sites; (4) financing of the acquisition and necessary improvements; (5) improvement of the site; and (6) operation and administration.

Responsibility for Program—It is well that the body responsible for the program be representative both of the civic authorities and local organizations, so as to take the question out of the realm of local politics and to arouse a maximum of public interest. This committee should have technical advice available to it if possible during its deliberations, but certainly before its final recommendations are submitted. It should decide upon the number of airports desirable, their location and the financial policy. The work of improvement and administration can be left to the civic authorities.

Legal Authority—A number of states already have statutes which specifically allow the acquisition, improvement and operation of publicly owned airports, while in others the end may be attained through general or specific powers granted by other statutes or local charters. Where the authority does not exist, however, it is essential that it be obtained as soon as possible.

Selection of Site—The selection of a proper site for an airport is the most important step in the entire program. Improper layout and design may be corrected at nominal expense, but improper location will result in the discouragement of the use of the site and may cause accidents which will revive the fast disappearing prejudice against aviation. The proper location of an airport, either large or small, is a highly technical problem, and expert advice should be had at the outset. Ten major factors should be considered in connection with each site under consideration, all of which, however, are not of equal importance. These factors and their relative importance under average conditions in the opinion of the author are given in the following table, the weights indicating the relative importance in a total scale of 100:

Factor	Weight, Points
Topography	10
Physical features	14
Meteorology	14
Location with respect to community served	10
Transportation facilities	11
Accessibility	11
Legislative control	5
Utilities available near or at site	5
Cost	10
General desirability of site from all standpoints	10
Total	100

The weight given each factor is suggestive only, and should be modified in the light of local conditions, size of community and of airport, principal use of field, etc. Each of these factors may be further subdivided and total weights assigned to each factor divided among the subdivisions thereof.

Each site under consideration should then be rated with respect to each factor given in the above tabulation on the following basis: excellent, from 90 to 100 per cent; good, 80 to 90 per cent; fair, 70 to 80 per cent; unsatisfactory, below 70 per cent. The summation of the products of the relative weights and the ratings given each weight will then give a percentage rating for each site under consideration.

Briefly, the site finally considered should meet as far as possible the requirements outlined in the following. The surface of the landing field should be flat, with a gentle grade not to exceed 2 per cent, should have surrounding landmarks which will easily identify it from the air and should be so located that its area may be extended if necessary. It must be protected from overflow and be kept free from mud and standing water at all times. Hazards such as high-tension wires, tall buildings and smokestacks should not exist or be allowed near the landing field.

The size of the field will depend upon its use and upon the ability of the community to finance its acquisition and improvement. The U. S. Department of Commerce has developed a rating system for airports in respect to general equipment, size and night lighting equipment. An area permitting landing or takeoff in eight directions with strips 1,320 ft. long is given a class 4 rating and can be contained in a 40-acre square tract, which is about the smallest area to be considered. Strips 1,600 ft. long permitting landing or takeoff in four directions at an angle of not less than 60 deg. receive the same rating. An eight-way landing with strips 2,500 ft. in length receives a class 1 rating. All landing strips must be 500 ft. wide. Space should also be available for hangars and for a service building on the site, and serious thought should be given to providing park and other recreational features adjacent to the site.

Usually meteorological conditions differ little in various sections of the community, but if there is a variation, a site should be selected which is free from in 1928 indicates that the total amount of explosives used

It is advisable to choose a location where flying over residential areas can be kept at a minimum. In communities of small area where prevailing winds occur, a location at right angles to the direction of the prevailing wind will prevent low flying over these areas and will allow open country to be flown over after takeoff, providing emergency landing areas where most needed, as most accidents to planes occur shortly after takeoff. In communities of larger area and population, a site should be chosen in the direction of approach of the major volume of air traffic so as not to require passengers and cargo to be flown over the community and then be brought back to town.

Rail transportation is not an important item in the small localities, but the airport should be located adjacent to good highways leading into the town and also radiating throughout the surrounding countryside; a site close to existing electric lines also is advantageous.

Although control such as policing and development of surrounding territory must be exercised by the community, it is not essential that the airport be located within the city limits if authority exists for ownership and operation outside. All sites must of course be within reasonable distance of such utilities as electric power, water, fuel, telephone and telegraphic facilities and fire protection, and the airport must be accessible to supplies of gasoline, oil and other necessities for airplanes.

In comparing costs of different sites under consideration, the costs must be brought to a common denominator, a site with a large cost for drainage, grading, etc., having these items charged against it when comparing it with one having small costs for these features.

Financing Aquisition and Improvements—Three methods are usually available for the aquisition of an airport site: (1) direct purchase; (2) straight lease; (3) lease with option to purchase at given prices at given times.

The direct purchase usually requires the submission of a bond issue to the voters of the community, and this cannot aways be put before the voters in such manner as to obtain their approval. With a straight lease the community may find itself anxious to purchase at the expiration of the lease, with the owners either asking too great a price or desiring to use the land for other purposes. It is usually advisable to make a lease for a period of years at a rental which affords the owners a fair return upon a reasonable valuation of their land, taking an option to purchase at stated prices either during the period of the lease or at its termination; a better way even than this is to include in the rental price an amount which will partly amortize the cost of the land.

Improvement costs can usually be raised from current revenues, and improvement programs made gradual so as not to become burdensome. Every airport should have charges established for use of both landing facilities and accessories, these charges including landing fees, storage either within or without hangars, use of night lighting equipment, and rental of concessions. These charges should be such as to pay the operating cost and a portion of the rental or cost of acquiring and improving the airport.

Improvement of Site—The proper layout of the airport is of utmost importance. The landing area should be kept absolutely free of obstructions of any nature and should have a surface upon which planes can travel under all conditions of weather. If a quick-draining soil does not exist, the landing area should be provided with a drainage system. If the soil is of a friable nature, it should be treated with light oil or a dust preventive. Landing strips at least 200 ft. wide should be provided which will remain firm and take the impact of heavy planes under all weather conditions. Concrete strips are usually too expensive for the smaller community, at least at first, but strips made of crushed rock, oil macadam or heavy turf are quite efficient; to reduce initial expense heavy oiling of the surface in the area of the strips will serve for a time.

The length and layout of runways will vary with local conditions. There should be at least two, crossing or converging at angles of not less than 60 deg., one of them (the longer if of uneven lengths) being laid out parallel with the direction of the prevailing wind. In no case should a runway be less than 1,320 ft. in length, and preferably should be from 1,600 to 2,000 ft. or longer. Clear approaches should exist at each end of all runways so that a plane rising on a 1 to 7 gradient will clear all obstructions.

Buildings should be located near transportation and if possible near the leeward side of the landing field to afford as little ground travel as possible after the plane is serviced and loaded. All buildings should be grouped as closely together as possible, should be of fire-resistant construction and should be painted or plastered a light color with a dull finish. A bulletin board for displaying meteorological information should be established near the field headquarters. A small machine shop for making repairs should be available, and a waiting room, administration office, fire station, garage and restaurant are desirable if the field is much used. Hangars should be provided for planes owned by local residents and for storage of planes owned by outside pilots who arrive at the field. All buildings should be of attractive design, and the grounds around them attractively landscaped so as to give a good impression both to local residents and visiting flyers.

Plans should be made to provide the airport with a beacon to identify it to pilots, boundary approach lights to indicate the best direction of approach, obstruction lights and lights to define the extent of the landing area.

Floodlighting is essential, and this should include the buildings and the wind direction indicator as well as a ceiling light.

The airport should also be marked for identification during daylight hours. This marking should include a circle marker at least 100 ft. in diameter, with a band 4 ft. wide, constructed of white material and placed flush with the ground, the name of the city or of the airport, an arrow pointing to the true north with the letter "N" placed north of it, and some conspicuous method of designating the boundaries of the landing area. In addition a wind cone to indicate the direction and probable velocity of the wind near the ground surface should be installed. All identifying marks should be painted white or treated with a coat of whitewash and maintained in good condition. They should be of such dimensions as to be clearly visible at an elevation of 3,000 ft. above the field.

Operation and Administration of Airports—In the smaller communities operation can usually be placed under the jurisdiction of the local engineering department, with the park or recreational department cooperating in their respective fields.

A manager residing at the airport should be provided,

and if the airport is extensively used someone should be in attendance both day and night. Rules for the use of the airport and its facilities should be promulgated as soon as the field is placed in operation, and copies of these rules posted in conspicuous places around the field, as well as made available for distribution.

While a municipal airport may be regarded as one of the municipal utilities, its ability to pay for itself will depend largely upon the local interest aroused in aeronautics, and this in turn will depend upon the location, improvement and intelligent administration of the port. A good airport within the next five years will be as good an advertisement for a town as a good hotel.

Intake Conduits for Water-Works of Hamilton, Ont.

Successive Use of Wood, Cast Iron, and Concrete on Shore With Steel in Lake, 1859-1927—How Laid Under Water

THE first source of supply (1859) of the water-works of Hamilton, Ont., was from an infiltration basin along the shore of Lake Ontario, ultimately 3,000 ft. long. A 38-in. wood stave conduit connected the basin with the pumping station. This combination served for 30 years, when the flow into the basin having diminished, a 20-in. cast-iron pipe was laid from the basin 880 ft. into the lake to a wood crib, with 20 ft. of water above its inlet. In 1901 the basin was extended and a 36-in. wood stave pipe (never used) was laid from the basin a short distance into the lake.

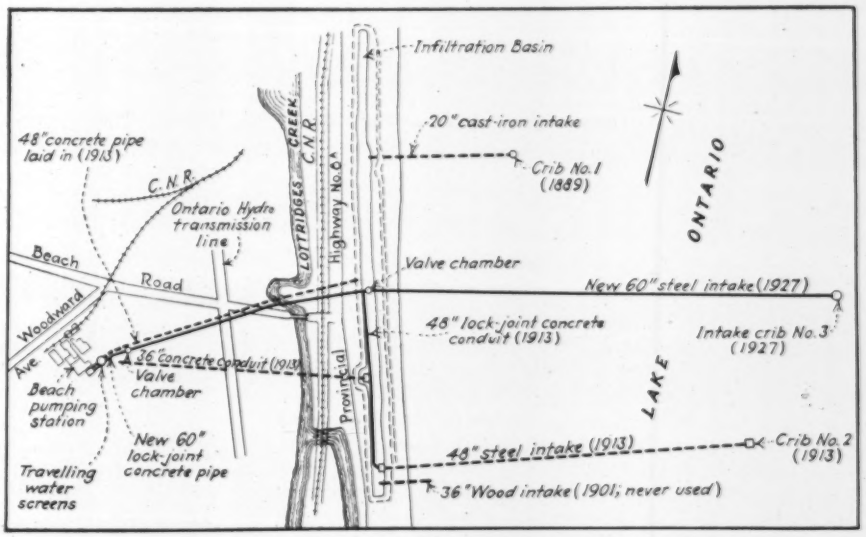
The next change was made in 1912-13 when (1) a 48-in. steel conduit was laid from the basin 2,144 ft. into the lake, with a depth of 33 ft. of water over the inlet; and (2) a 48-in. concrete conduit was laid from the basin to the pumping station. The new work of 1927 resulted in large part from a short but almost complete ice stoppage through the 48-in. pipe line. This occurred in 1923. In 1926 recommendations were made that the infiltration basin be abandoned, a new 60-in. conduit be laid from the pumping station to a new intake crib and that the two runs of 48-in. pipe, laid in 1912-13, be joined by 1,200 ft. of 48-in. pipe. This work was done in 1927, using lock-joint steel pipe from the pumps to a valve chamber in the basin, a distance of 1,200 ft., and steel pipe for the remaining 3,000 ft. to the new intake.

The foregoing summary is taken from a paper by H. S. Philips and James Stodart, of the city engineer's office, Hamilton, Ont., read before the Engineering Institute of Canada on Feb. 15 and given in full in *The Engineering Journal* of the Institute for February. The authors describe the method of laying the 48-in. pipe, in the lake, in 1912, as follows:

Work was begun in the infiltration basin and carried outward into the lake. The equipment used consisted of a scow fitted with a derrick and clamshell for excavating, and pipe-lowering equipment at each end, a piledriving scow, and steam tugs. The bearing piles were first driven, and then sufficient trench was dredged out for one pipe length. Bearing piles were then cut to grade and capped, and the pipe was lowered from the bottom of the scow. All trench was backfilled after the pipe had been laid. The wooden crib was built on shore, floated out to position and placed. Two expansion joints were used on the line, and wedge-shaped wooden gaskets were used for changes in grade. The 48-in. riveted steel pipes were [in sections] 142 ft. long, delivered on the lake shore in lengths of between 20 and 30 ft. and assembled to the required length.

The new 60-in. steel intake (1927) was fabricated on shore in 24 lengths, each except the closing length about 126 ft. long. The plates were ½ in., with double-riveted longitudinal and single-riveted circumferential joints. Five cast-iron flexible joints were provided. Each 126-ft. length is supported on three pipe bents, with rolling blocks bolted to the caps. Where the trench fill was over 6 ft. deep, the pipe was incased with 12 in. of 1:3:5 concrete. The method of laying the pipe follows:

The pipes were laid from the side of a barge fitted with steam winches and two outriggers, concrete counterweights being used on the opposite side for trimming. When everything was ready for pipe laying, the barge was brought into line and correct position, and bulkheads were removed. The pipe was then lowered on the bents and faced up. The flanges were next bolted by divers in from two to three hours and the rolling blocks secured. During the work the pipes were held by the slings from the outriggers.



LOCATION OF WATER-WORKS INTAKES, HAMILTON, ONT.

Where the pipe is incased in concrete, pouring was done from a scow fitted with a mixer, concrete being placed in forms through tremie pipes. Forms were built with angle plates, which rode the top of the pipe, were fixed to the top horizontal braces to insure the proper vertical position of forms and also the proper depth of concrete.

The crib for the new 60-in. intake conduit is 22 ft. in diameter, built of interlocking sheet piling, assembled on a scow, floated to position and lowered by a derrick scow. It rests on shale. There are six intake ports, each with an area of 54 sq.ft. designed to give a velocity of 1.45 sec.-ft. at time of maximum draft. Winter velocities will be lower, because the highest water consumption is in summer; velocity in the 60-in. conduit is 4.7 sec.-ft.

Blasting Settles Road Fills in Minnesota Muskeg

Step-by-Step Blasting Procedure Described, With Graphs for Figuring Explosives and Illustrations of Light Equipment Suitable for Fast Operation in the Field

By P. W. Riedesel
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Formerly Resident Engineer, Minnesota Highway Department

Introduction

There are in Minnesota many areas of muskeg, or soft ground, and sometimes it is absolutely necessary to cross these swamps with highways. In case of the lighter highway of former days, it was usual to carry the road by a light fill placed on corduroy. This method of support was sufficient for the ordinary light embankment and such vehicles as passed over it.

With the advent of the motor vehicle, however, and the increase of loads and the demand for wider and higher sub-grade, this method was no longer satisfactory. In so far as possible without sacrificing alignment, roads are located so as to avoid these swamps, but often it is absolutely necessary to cross soft ground with highways which are to be paved in the very near future. Obviously it is impossible to load these places and wait eight or ten years for final settlement and as a means of accelerating the settlement blasting is being resorted to.

The article which follows gives details of drilling, loading and shooting, as well as information as to the amount and kind of powder to use. It may be said here, however, that the method is successful in securing early settlement of a fill over deep swamps: it has been used on swamps as deep as 60 ft. While the results are satisfactory, the process is somewhat expensive and is not recommended except where accelerated settlement is demanded.—J. T. Ellison, *Chief Engineer, Minnesota Department of Highways, St. Paul, Minn.*

THE first use of explosives deep within a peat bed under a fill to displace the soft material and sink the overlying fill was perhaps by Mr. Acton, in 1926, when he was engineer of St. Louis County, Minnesota. With this experience as a starting point, the Minnesota Highway Department has used blasting to settle fills on several trunk highways. In this experience it has been able to advance the general technique by preliminary shooting and by adding some new things in the way of equipment.

Blasting Procedure

In preparing for blasting the swamp across which the fill is to be placed should be examined for possible drainage. The depth of peat and muck going deep into the firm underlying strata should be sounded to make certain that a thin hard layer in the muck bed is not mistaken for the real bottom. The depth of the overlying tough sod covering and the groundwater level should be noted. These factors will affect the size of the charges to be used in both the preliminary and the deep shooting.

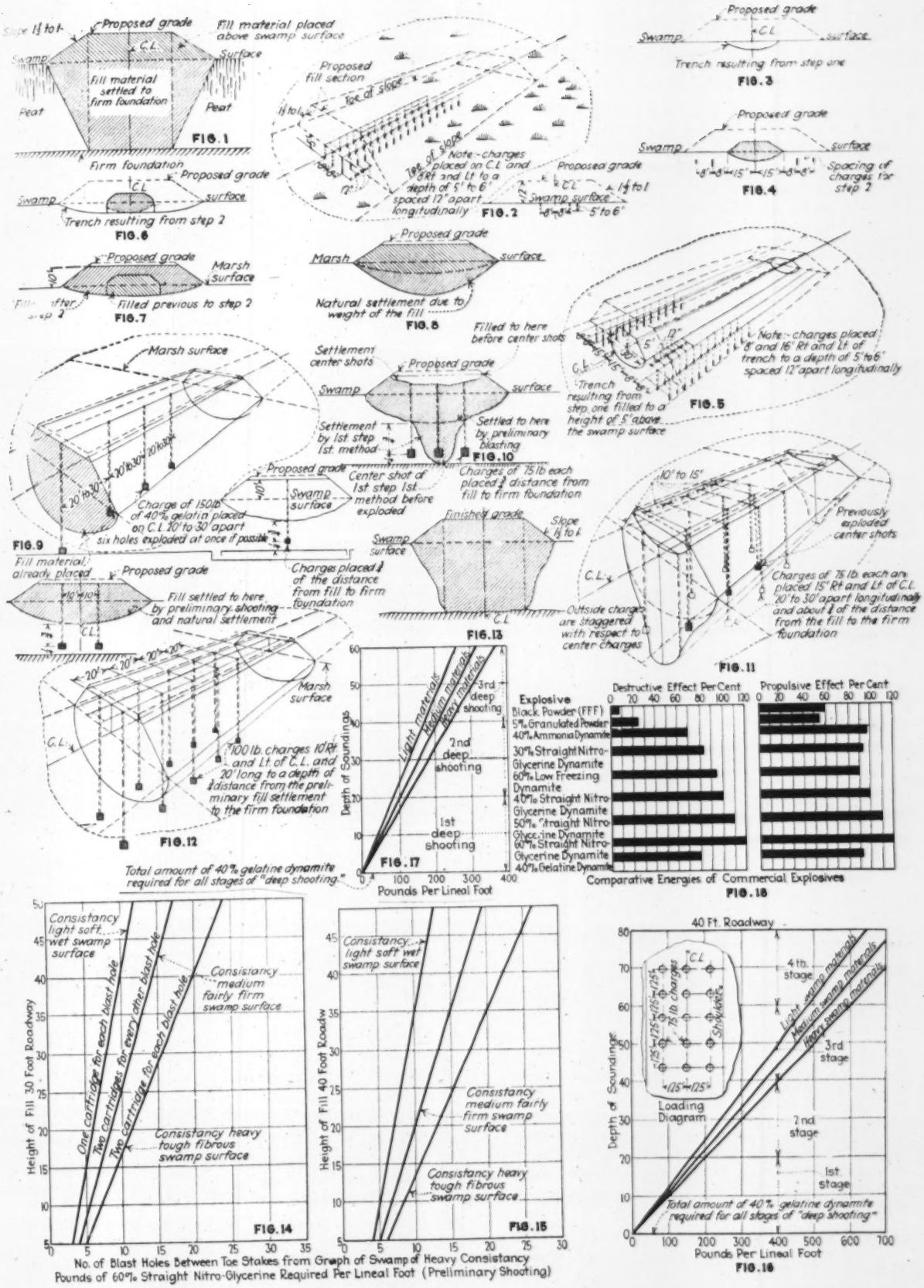
Preliminary Shooting—In the grouped drawings, Fig. 1 shows the proposed ideal section for subsurface fill. Fig. 2 illustrates step 1 of the preliminary shooting and shows the depth and spacing of the charges. If the groundwater level is high and the turf covering light, a ½-lb. cartridge per foot will probably be sufficient. More difficult conditions will require more powder.

Experience has shown that a 60 per cent straight nitroglycerine dynamite gives the best results. It is very sensitive to the detonating vibration, which must cross the 1-ft. gap of peat between cartridges. On most of the work electric exploders, connected in series, are placed every 20 ft. On occasion, though, a row of 100 ft. has been shot using only one exploder. Holes for the dynamite are easily made by a few vertical strokes with a heavy crowbar. The ½-lb. dynamite cartridges are then pushed into position with a wooden loading stick. The charge is exploded with an electric blasting machine.

One practical detail to be observed is the assistance of a wind at right angles to the center line of the road in carrying the blasted material clear of the area between toe stakes. When work is undertaken well in advance of grading operations, advantage can often be taken of the direction of the wind. Occasionally some piles of loose material will be left in the center of the blasted trench. Usually these can be removed by a concentrated charge of 25 to 30 sticks of dynamite. The results of the first step, preliminary shooting, is shown by Fig. 3.

Step 2 is placing the first fill as shown by Fig. 4. Immediately after placing this core, step 3 (Fig. 5), the final preliminary shooting, is accomplished. Note the function of the first fill core here. It keeps the trench formed in step 1 from being filled with loose material and controls to a degree the direction taken by the blasted material of the second shooting, forcing it outward and away from the center of the fill as shown by Fig. 6.

Step 4 (Fig. 7) consists of placing fill to the height of 10 ft. or more. In case the completed fill is to be less than 10 ft. in height above the swamp level and the soundings show deep soft material, it will still be advisable to carry this additional height of fill because of the settlement certain to be got. Judgment and knowledge of general conditions should indicate the required height. In any case fill of sufficient depth and weight should be placed to insure settlement into place when the deep shooting is done. In this connection observe Fig. 8, which shows settlement due to the weight of the fill itself. In very soft material the drill holes for the deep shooting when made at the center of the fill will sometimes reveal this settlement (natural settlement) complete, or almost complete, to the firm foundation material.


Proposed grade
Fill material placed above swamp surface
Swamp
C.L.
Surface
Fill material settled to firm foundation
Peat
Peat
Firm foundation
FIG. 1
Proposed fill section
Toe of slope
1½ to 1
Note - charges placed on C.L. and 8 Rt. and Lt. to a depth of 5' to 6' spaced 12" apart longitudinally
FIG. 2
Proposed grade
Swamp
C.L.
Surface
Trench resulting from step one
FIG. 3
Proposed grade
Swamp
Surface
Spacing of charges for step 2
FIG. 4
Proposed grade
Swamp
C.L.
Surface
Trench resulting from step 2
FIG. 6
Proposed grade
Marsh surface
Filled previous to step 2
FIG. 7
Proposed grade
Marsh
Surface
Natural settlement due to weight of the fill
FIG. 8
Filled to here before center shots
Note - charges placed 8' and 16' Rt and Lt of trench to a depth of 5' to 6' spaced 12" apart longitudinally
Trench resulting from step one filled to a height of 5' above the swamp surface
FIG. 5
Marsh surface
Charge of 150 lb of 40% gelatin placed on C.L. 20' to 30' apart six holes exploded at once if possible
FIG. 9
Settlement center shots
Proposed grade
Swamp
Surface
Settlement by 1st step 1st. method
Settled to here by preliminary blasting
FIG. 10
Proposed grade
Center shot of 1st step 1st method before exploded
Swamp surface
Charges of 75 lb each placed ⅓ distance from fill to firm foundation
Finished grade
Slope 1½ to 1
Swamp surface
C.L.
FIG. 13
10' to 15'
Previously exploded center shots
Charges of 75 lb each are placed 15' Rt and Lt of C.L. 20' to 30' apart longitudinally and about ⅓ of the distance from the fill to the firm foundation
Outside charges are staggered with respect to center charges
C.L.
FIG. 11
Fill material already placed
Proposed grade
Fill settled to here by preliminary shooting and natural settlement
Charges placed ⅓ of the distance from fill to firm foundation
C.L.
Marsh surface
100 lb. charges 10' Rt and Lt of C.L. and 20' long to a depth of ⅓ distance from the preliminary fill settlement to the firm foundation
FIG. 12
Depth of Soundings
Light materials
Medium materials
Heavy materials
3rd deep shooting
2nd deep shooting
1st deep shooting
Pounds Per Lineal Foot
FIG. 17
Total amount of 40% gelatine dynamite required for all stages of "deep shooting."
Explosive
Destructive Effect Per Cent
Propulsive Effect Per Cent
Black Powder (FFF)
5% Granulated Powder
40% Ammonia Dynamite
30% Straight Nitro-Glycerine Dynamite
60% Low Freezing Dynamite
40% Straight Nitro-Glycerine Dynamite
50% Straight Nitro-Glycerine Dynamite
60% Straight Nitro-Glycerine Dynamite
40% Gelatine Dynamite
Comparative Energies of Commercial Explosives
FIG. 18
Consistancy light soft wet swamp surface
Consistancy medium fairly firm swamp surface
Consistancy heavy tough fibrous swamp surface
One cartridge for each blast hole
Two cartridges for every other blast hole
Two cartridges for each blast hole
Height of Fill 30 Foot Roadway
FIG. 14
Consistancy light soft wet swamp surface
Consistancy medium fairly firm swamp surface
Consistancy heavy tough fibrous swamp surface
Height of Fill 40 Foot Roadw
FIG. 15
40 Ft. Roadway
C.L.
Shoulders
75 lb. Charges
Loading Diagram
4th stage
3rd stage
2nd stage
1st stage
Light swamp materials
Medium swamp materials
Heavy swamp materials
Depth of Soundings
Total amount of 40% gelatine dynamite required for all stages of "deep shooting."
Pounds Per Lineal Foot
FIG. 16
No. of Blast Holes Between Toe Stakes from Graph of Swamp of Heavy Consistancy
Pounds of 60% Straight Nitro-Glycerine Required Per Lineal Foot (Preliminary Shooting)

FIGS. 1-18—DIAGRAMS AND GRAPHS FOR CONDUCTING BLASTING OPERATIONS IN SETTLING SWAMP FILL

At least four definite objects are accomplished by the preliminary shooting:

1. Where the swamp is overlain with heavy turf, it opens the way to some immediate natural settlement.

2. It makes more certain the accelerated settlement due to the deep shooting which follows.

3. It saves in the amount of power necessary for the deep shooting.

4. Where the swamp is deep and filled with a soft saturated material and a sink hole is likely to develop, it controls the direction of the settlement, lessening to a large degree the danger of side slip and the consequent loss of a large amount of fill. By side slip is meant the penetration of fill material into an area outside the proposed ideal subsurface section.

Deep Shooting—With the fill well started (Figs. 7 and 8) in the direction of firm foundation, the time is ready for accelerating further settlement by deep shooting. A glance at step 5 (Fig. 9) illustrates the first operation. The theory of the process is also quite plain. When the explosion occurs, with its rapid expansion of gases, they meet with resistance against the firm foundation material and the heavy weight of overlying fill. The line of least resistance is through the soft material immediately under the fill core. A void is formed by the lateral displacement of this soft material and the heavy overlying fill is drawn by gravity into this space.

Fig. 9 shows the spacing of the blast holes along the center line, and the depth and amount of charge generally placed. Where possible, it is attempted to explode the charges from four to six holes at one time. With a powerful blasting machine more could be set off, but it has been found most practicable to handle the work in station lengths of 100 ft.

Where the peat formation is deep, say 20 ft. and over, one shooting may not be sufficient to settle the fill to the firm foundation. Here settlement should be accomplished by successive shootings and the charges should be placed closer to the point in the wedge of overlying fill material. Fig. 10 shows the result of the shooting described as first operation. It and Fig. 11 show the location of charges for the second operation and their relation to the charges placed in the first operation. It must be borne in mind that it will often be found necessary to raise the fill section above the swamp surface to keep up the supply of fill material.

Fig. 12 illustrates the placing and weight of charges that have been used on some of the work. Good results have been obtained by this alternative method. Fig. 13 is a section of the completed fill.

During the 1928 season, using power drills which speeded up the work, a closer spacing was often used than is shown in any of the methods outlined above. Smaller charges per blast hole were placed and equally good results obtained. More numerous blast holes with lighter charges are especially desirable where the height of the overlying fill is less than 10 ft., because of a less destructive effect on the fill.

General Lessons—Some fill materials will settle and occupy the void formed by the blast much better than others. Sand and gravel will drop into place almost at once. With clay the action is sometimes different; always some of the bottom layers of a clay fill will immediately drop into place, but the top layers will at times arch over the void. For this reason experience favors rather overcharging the blast holes in clay fills. When this is done, a considerable explosive force is expended upward, shaking and loosening up the overlying fill so that it will more readily settle into place.

Water is another settling agent that can usually be brought into play. For example trunk highway No. 10, between Stations 740 and 744, was being blasted to settle a heavy clay fill. The shots were set off one evening just before a heavy rain. There was some appreciable immediate settlement. During the night, however, the loosened fill was thoroughly drenched by the heavy rain,

TYPICAL COST RECORDS ON TWO PROJECTS

STATE PROJECT 10-49, HENNEPIN COUNTY, MINNESOTA; LONG LAKE-WAYZATA

Total length of swamp shot, ft.	1,200
Total amount of explosives used, lb.	4,500
Cost of explosives per linear foot of swamp	$1 23
Labor cost of shooting per linear foot of swamp	0 55
Labor cost per linear foot of swamp to put fills in shape for hauling	0 15
Labor cost of test drilling to determine penetration of fill	0 36
Total cost per linear foot of swamp shot	$2 29

This total per linear foot covers all materials and labor for doing the work and the incidental work made necessary by the shooting.

STATE PROJECT 10-55, HENNEPIN COUNTY, MINNESOTA; DELANO-LONG LAKE

Total amount of explosives used (two swamps), lb	8,050
Total length of swamp shot, ft.	930
Cost of explosive material per linear foot swamp	$1 72
Labor cost of shooting per linear foot swamp	0 50
Labor cost per linear foot swamp to put fill in shape for hauling	0 24
Typical cost per linear foot of swamp shot	$2 46

arch action in the upper layers of the fill was destroyed and next morning large craters appeared at every blast hole. Water is usually present in such locations at or near the surface, so on the next fill to be shot, dikes about 2 ft. high were built along each shoulder and a 6-in. centrifugal pump was set up and water was pumped between them for a week with good results.

Where bridges or culverts are to be built in such a swampy area, the fill should be constructed first entirely across the drainage channel and settled to firm foundation. Special precautions and heavier shooting should be employed to insure thorough settlement to firm foundation. If a volume of flow in the channel must be handled during the operation, settlement at a convenient point in the fill near by should be made and a cheap temporary drainage structure built to handle the flow while blasting is being done at the bridge or culvert site on the permanent channel. Work of this nature was carried out this season with good results.

Explosives and Charges

As previously stated, in preliminary shooting 60 per cent straight nitroglycerine dynamite is the most satisfactory. For the deep shooting 40 or 60 per cent gelatine dynamite is used. Due to its water-resisting qualities, gelatine dynamite makes an excellent explosive for this class of work. For charges easily placed, 40 per cent is the more economical. Where difficult loading is encountered, 60 per cent is better, because the bulk of the charge can be reduced 25 per cent.

The amount of blasting necessary, of course, depends on the depth of swamp, the consistency of the material and the height of the groundwater level. Careful preliminary soundings and investigation must be made. With this knowledge and a few test shots a reasonably accurate estimate of the amount of shooting can be made.

The graphs, Figs. 14 to 17, were made up as a guide in calculating the amount of explosives necessary. A study of the weekly reports made by the blasting crew in 1928 indicate that the total amount of explosives used

is very close to that given by the graphs. Fig. 18 is added as interesting information on the comparative destructive and propulsive effect of various commercial explosives.

Drilling and Loading Equipment

The great difficulty in swamp blasting is in drilling and loading the blast holes for the deep shooting. There are several kinds of machines and equipment that are readily adapted to it. The practice at first was to drill down as far as possible through the overlying fill with a 4-in. earth auger. Occasional small boulders and rocks encountered can usually be shot out of the way with a half-stick of dynamite. A supply of fuse and caps must be kept on hand for this work. When progress with the auger is stopped by the filling of the bottom of the hole with soft mud, a 2-in. loading pipe is lowered into the hole and driven farther into place with a special pipe driving tripod. The charges of dynamite are placed through this pipe. The tripod outfit can be built and equipped with tools, pipe and augers for $175.

At the beginning of the 1928 season four power drills were put into service. They have been a very great help. The speed of putting down blast holes has been greatly increased. Holes can be spaced closer and individual charges reduced. They are also a great help in test drilling. As soon as a fill is shot test borings can be made to determine the penetration and further blasting can be done immediately where it is found necessary. It might be noted that pipe driving and loading methods are essentially the same as given in detail for the hand tripod outfit as follows:

The tripod pipe driving device (Fig. 19) used on state project 10-49 was made up of tamarack poles cut in one of the swamps. It was lashed together with ½-in. rope, forming the familiar army tripod often used in constructing spar bridges. From the vertex of this tripod was hung a single sheave tackle block over which a ¾-in. rope passed. One end of the ¾-in. rope was attached to the ring in the driving block, the other to the source of power. Hand power was used. Two good active men on the power end of the rope could send the loading pipe down at a lively clip.

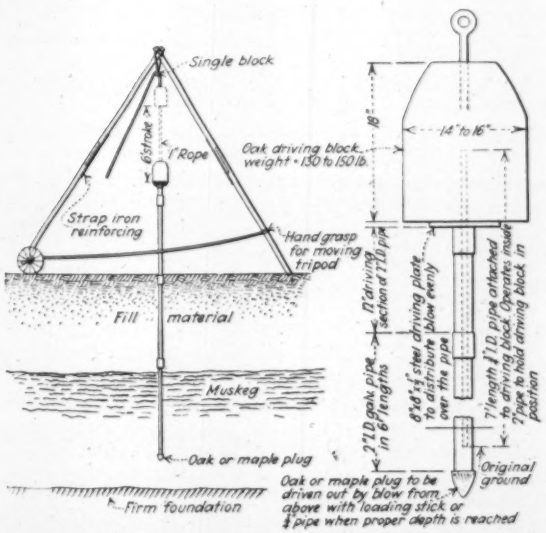

Single block
6' stroke
1" Rope
Oak driving block, weight = 130 to 150 lb.
14" to 16"
Strap iron reinforcing
Hand grasp for moving tripod
Fill material
12' driving section of 7" O.D. pipe
6"x6"x¼" steel driving plate to distribute blow evenly over the pipe
7' length 7" O.D. pipe attached to driving block. Operates inside 7" pipe to hold driving block in position
Muskeg
2" O.D. galv. pipe in 6' lengths
Oak or maple plug
Original ground
Firm foundation
Oak or maple plug to be driven out by blow from above with loading stick or ¾" pipe when proper depth is reached

FIG. 19—TRIPOD AND HAMMER HEAD FOR DRILLING BLAST HOLES

The drawings, Figs. 19 and 20, illustrate the method of driving and raising the loading pipe. A few words of explanation might be added. To the lower end of the oak driving block a ¾-in. guide pipe is firmly attached. This guide pipe operates through the ½-in. steel plate

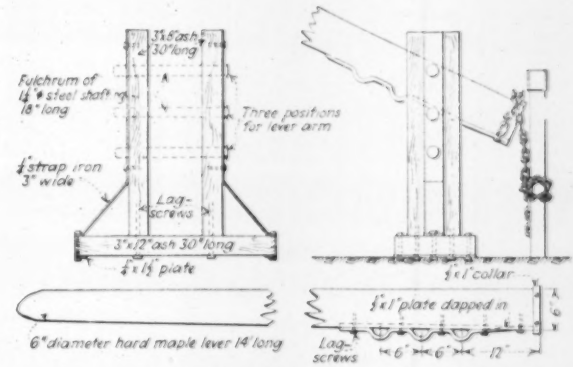


FIG. 20—JACK FOR PULLING BLAST HOLE PIPE

vertically up and down within the 2-in. pipe so that a direct blow of maximum effect is delivered. The ½-in. steel plate rests directly upon the pipe to be driven and serves to distribute the blow. In driving, the block is raised vertically 5 or 6 ft. by hand power; the power is thus released and the block is allowed to fall freely. Using an oak block weighing from 135 to 150 lb., with a stroke of 5 to 6 ft., the penetration is from 6 to 12 in. per blow. Three men have drilled, loaded and shot six holes, averaging 30 ft. in depth, in one ten-hour day.

After driving the loading pipe down to the desired depth within the peat, the wooden plug (or cheap cast-iron plugs can be obtained) is driven out by a sharp blow from above with a loading stick or pipe operating inside of the loading pipe. A hole below the loading pipe for the springing charge can be made by ramming with a loading stick or a 6-ft. length of shafting coupled to a 1-in. pipe. The springing charge with electric blasting cap and fuse is lowered through the pipe and pressed into position with a wooden loading stick. The loading pipe is then raised 2 or 3 ft. and the hole sprung. The main charge is now placed through the pipe and pressed into position with the wooden loading stick. The primer cartridge, with its electric blasting cap, is placed in a snug-fitting protective tin container, the size of a dynamite stick fashioned with a conical arrow-like point. This primer cartridge is placed last, pressed into the mass of explosive already in place and the loading stick is withdrawn. The conical arrow-like point serves to hold it in place, preventing its withdrawal when the loading stick is removed. The loading pipe may now be removed, care being taken not to injure the wiring.

Chlorinated Copperas as Coagulant: Correction

Chlorinated copperas, or more specifically chlorinated sulphate of iron, is used as a coagulant at the water filtration plant at Elizabeth, N. C., instead of sulphate of copper, the latter as stated through a typographical error in the report of the Virginia Water and Sewage Works Association, p. 724, *Engineering News-Record*, May 2, 1929. The chlorine is used to oxidize the iron from the ferrous to the ferric state. The iron sulphate is a by-product in steel and in titanium oxide plants.

Triangulation by Mozos

Perhaps the First Instance Where Native Mexican Indians Had Responsible Charge of a Survey

By G. H. T. Shaw
La Salle, Ill.

AN ENGINEER in foreign fields is often confronted with a situation calling for a solution not to be found in any textbook. Not the least source of a proper satisfaction in the successful completion of his task comes from the knowledge of having overcome obstacles that at first appeared to be unsurmountable.

"Necessity is the mother of invention." Trite but very true, as an experience of the writer proved at one time in the back-country region of Mexico, which may interest "old timers" who have had many such problems to solve with only their native wit and resourcefulness to see them through.

For several years I had been working around the perimeter of a very large tract of timber land situated along the high ridge of the Sierra Madre del Sur in the State of Guerrero, Mexico, with two objectives in view. One was to construct a fairly accurate sketch map of the property and another was to "tie down" the outside edge of the tract by signing up a legal agreement with each adjoining property owner so as forever to define and fix the exact boundary line.

Anyone acquainted with the vague and hazy legal descriptions so generally obtaining in Mexico who will also take into consideration the very human tendency of native landowners constantly to expand their limits will require no argument to realize the desirability of such boundary contracts.

Method of Operation

The field work for the building up of a sketchmap of each section of the perimeter (divided into lengths according to the extent of the different adoining properties) consisted of making reconnaissance trips along and upon the boundary line or as near to it as the extremely broken topography would permit, taking compass bearings and estimating distances from various high elevations to other prominent points in view, identifying such points and named boundary points also. The more such bearings that were obtained, crisscrossing the whole region in view, the more accurately could the final adjusted sketch be compiled. As a baseline the distance between at least two points was determined with considerable accuracy either from known data or by measurement. At the time of taking each bearing a note was made of the apparent distance of the object in view. Long experience in reconnaissance field work, preliminary to surveys for railroads through mountainous country, had given the writer a good schooling in judging of airline distances over broken country—something that the uninitiated find very difficult.

Working out from the city of Coyuca de Catalán, State of Guerrero, I had completed every section near there with the exception of the length along the large hacienda of Santa Fé, a length of some 12 km. in very broken country. The extremities of this section were fairly well located, but nothing was known of the intermediate points on the boundary except the description given in the legal "possession" document as set down in the year 1797, naming "a pass near the hill Tasagera," an extremely ancient stone known as the "Piedra de los Fierros," a pass near the "Cerro de las Botijas" and a "pass near the Cerro de la Estrella."

For many months I had been dodging in and running out, getting field work done while bandit gangs were roving around all over the place, but in this particular section there happened to have as his headquarters a certain character, Marcelino by name, who had given me a close call some time previously and I had no desire to afford him another opportunity of getting me in his possession for purpose of ransom.

My personal "mozo" (servant) for a long time had been Federico Peñaloza, and it had been my custom when out on reconnaissance trips to teach him to estimate air-line distances. He had become quite proficient, or at least to the extent that his estimates quite uniformly approximated my own. Federico could not read or write but could read figures. His chum, Antonio, a local "muchacho de la musica" (musician), was "lettered" to a certain degree.

Using my U. S. Army Engineer's prismatic compass reading full circle figures from 0 to 360 deg., I taught these boys, first in the patio of the company house and then out in the open country, to read bearings. For several days I drilled them by having each one read the bearing to a certain object and then checking it myself. They took great pride in the work and became quite accurate.

Indian Boys "on Their Own"

I then started the boys off to do the field work along the Santa Fé boundary. In a notebook I wrote out explicit instructions; first to go to the hacienda and secure the assistance of a local guide who knew not only all of the mountain trails but also the names of the prominent topographical features of that section; an additional guide was to be secured from among the natives on the company's side of the line; then they were to commence at the "Cerro de la Tasagera" and take bearings to all known points in view; then to proceed as nearly as possible along the boundary line, climbing each eminence and taking bearings in all directions, especially to points already visited and advance points on or near the boundary line, identifying and locating each point named in our "possession" document, etc. Federico was instructed to make a careful estimate of the distance to accompany the notation of each bearing.

The boys returned and turned in the book nearly filled with "field notes." The writing was a beautiful script, the spelling a wonderful example of phonetic construction and the grammar such as is used by uneducated Mexicans, but the figures of distances and bearings were clear and the intention of the notes was easily figured out. The work plotted out remarkably well; even the final "tie-in" at the "Cerro de la Estrella" fell reasonably near to my previously ascertained location of that mountain.

A map was constructed and used in the boundary contract. It was, of course, titled as being simply a "croquis" (sketch), and the legal value of the document rested upon the naming of the various boundary points, but the map served the purpose of satisfying the adjoining landowner and also filled in the gap in my large map. I hope to live to see a map of that section constructed from instrumental surveys. I am sure that the "croquis" will not be materially wrong in any way.

It is the first instance I know of where uneducated native Mexican Indians have been in "responsible charge" of a triangulation survey.

Cableway Carries 5-Ton Load Across Span of 2,295 Ft.

Unusually Long Span for Conveying—Type Used on Hetch Hetchy Project—Data on Sag With and Without Load

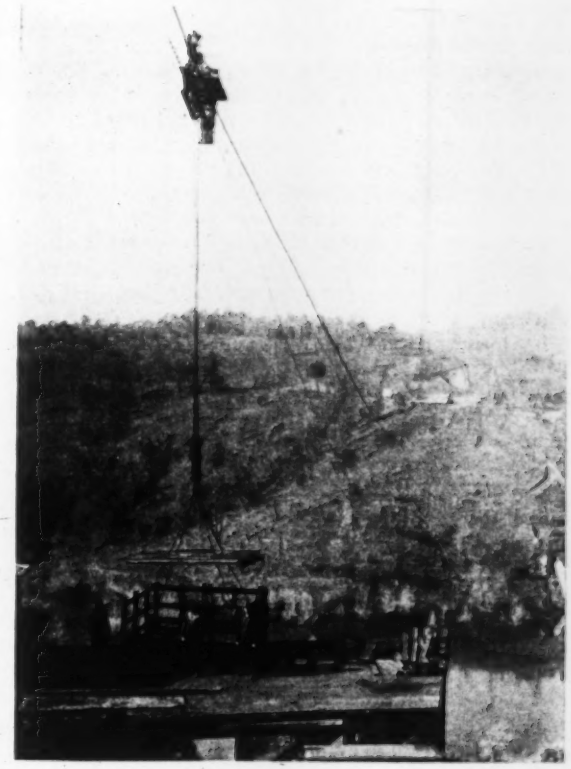
By Leslie W. Stocker
Assistant City Engineer, San Francisco, Calif.

A CABLEWAY notable for length of span is in service on the Hetch Hetchy project, which is to bring a new water supply to San Francisco. The cableway is located almost directly over the Red Mountain Bar siphon built to convey Hetch Hetchy water across Tuolumne Canyon, which is now occupied at this point by the Don Pedro reservoir. In this location the cableway transports all men and materials moved between a point on the Hetch Hetchy railroad on the west side of the reservoir and an adit of the Foothill division tunnel on the east side of that reservoir.

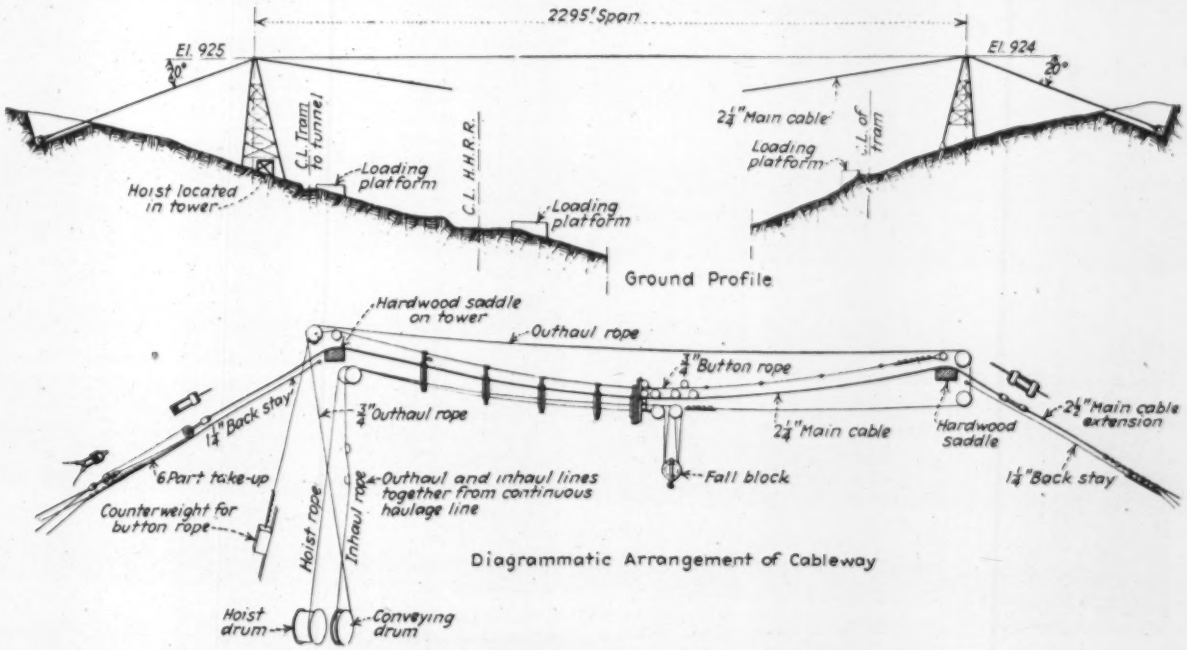
Supporting towers of timber were erected at either end of the span, which is 2,295 ft. long. The head tower, which houses the hoist, is 85 ft. high and the tail tower 61 ft. high. The hardwood saddles at the top of these towers that carry the main cable are within 1 ft. of the same elevation. The towers were located so that the length of span would be the shortest that would permit of picking up loads at the west end of the cableway, either from cars on the railroad siding or from motor trucks beside it, and delivering to a platform beside a tramway on the east side that leads to the adit portal about 2 miles away.

The entire installation was designed for a maximum hook load of 5 tons. The main cable is of "improved plow steel" 2¼ in. in diameter and has an estimated ultimate strength of 210 tons. The main cable was erected with an initial unloaded sag of about 125 ft. The total weight of carriage and hook is about 5,000 lb., making a maximum concentrated load of 7½ tons when the hook carries 5 tons. Measurements taken shortly after installation showed that the sag increased to 134 ft. when the unloaded carriage was at the center of the span, and to 149 ft. with a 5-ton hook load at the center.

The cables themselves were purchased new for this installation; the carriage, hoist, motor and other parts of the equipment had previously been used by the United



RED MOUNTAIN BAR CABLEWAY FROM THE EAST END
Don Pedro reservoir in middle foreground. Part of Red Mountain Bar siphon at extreme right end.



PARTIAL PROFILE AND SKETCH OF CABLEWAY ARRANGEMENT

States Reclamation Service on the Arrowrock and Tieton dams. As delivered to the job the equipment included a three-drum hoist driven by a 300-hp. motor. The conveying speed is 1,200 ft. per minute and the hoisting speed 300 ft. per minute, a four-part hoisting line being used. The motor is larger than would have been selected had it been purchased new for this particular installation, and the third drum, designed for operating a dump rope, was not used in this installation.

The inhaul and outhaul ropes really constitute a single endless conveying rope. These lines, the hoisting or "fall" ropes and the button rope are all ¾-in. steel cable. Thirteen buttons and fall rope carriers are used.

The primary purpose of the cableway is to hoist load from the loading platform at either end, convey it to the other end without intermediate stops and lower it to the delivery platform. However, loads are sometimes picked up from barges on the surface of the reservoir, 300 ft. below the cable.

The Hetch Hetchy project is being built under the general direction of M. M. O'Shaughnessy, city engineer. The general design of the cableway was made by the writer, and the detailed design of towers and anchorages by the late R. P. McIntosh.

Floating Airports Planned for Transocean Travel

Unique Structures With Areas of 1,200x400 Ft. to Be Supported on Framework of Floating Steel Columns

DESIGNS have been completed and fabrication is soon to start on the first of a series of floating airports or seadromes to be distributed at 400-mile intervals across the Atlantic, according to a recent announcement. The first seadrome avowedly will be an experiment and will be anchored about 300 miles at sea, half way between New York and Bermuda. It will consist of a steel plate platform, 1,200 ft. long and 400 ft. wide, elevated about 75 ft. above the surface of the ocean by a braced framework of floating columns of unusual design. In Fig. 1 is given an artist's conception of the appearance of the completed seadrome, whereas Fig. 2 is an illustration of a model used in recent tests which gives some idea of the makeup of the substructure.

The plan was conceived and the initial design completed in 1922 by Edward H. Armstrong, an engineer with E. I. du Pont de Nemours & Company, Wilmington, Del. Subsequent experiments on models indicate to Mr. Armstrong's satisfaction that the seadrome can resist waves up to 180 ft. in height; the maximum wave height experienced in the Atlantic is about 30 ft.

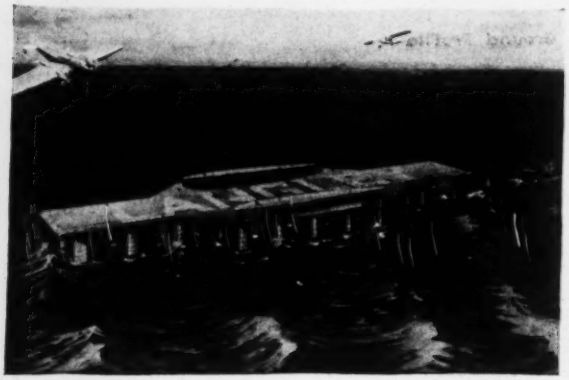


FIG. 1—ARTIST'S DRAWING OF OCEAN AIRPORT

The design of the seadrome is based upon two principal facts: (1) that no wave effect is perceptible 50 ft. or more below the surface, and (2) that a structure offering no resistance to the waves and with its hull above the surface disturbances will not pitch and roll.

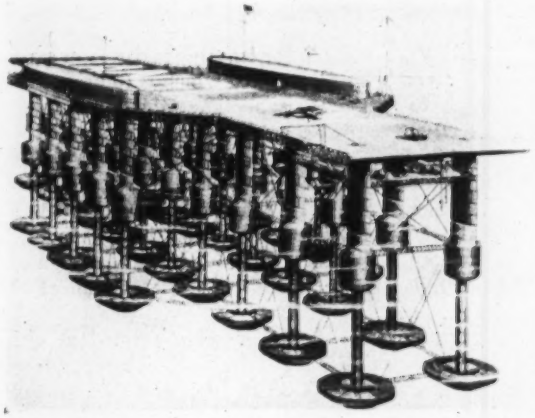


FIG. 2—STRUCTURAL DETAILS OF SEADROME SHOWN BY MODEL

The field will be 1,200 ft. long, 400 ft. wide over all at the center, with certain portions of its space taken up for hangars, hotel, restaurant and machine shops. As shown in Fig. 2, the landing surface is supported upon riveted plate columns having somewhat the shape of glass retorts. Buoyancy chambers, the tops of which are approximately 75 ft. below the landing surfaces, contribute the principal support. These chambers are 35 ft. high and ride just below the water surface. The cross-section of the floating columns above the buoyancy chamber is elliptical in shape. Below the buoyancy chamber it assumes a circular cross-section that is 7 ft. in diameter for a distance of 63 ft., at which point it telescopes into a circular section 9 ft. in diameter, which continues down to the base disks, a total of 70 ft. below the bottom of the buoyancy chambers. The disks themselves are to be filled with iron ore ballast to lend further stability. Diagonal rod bracing is used between the various columns, while trussed struts join the columns at the disks, at the top of the buoyancy chambers and at the deck level.

The anchorage cable, 21,150 ft. long, will be divided into four sections of varying diameters, the first section 1½ in., the next 1⅞ in., the third 2¼ in., and the final section, which reaches to the surface and is attached to an elongated bar buoy about 60 ft. long, 2¼ in. in diameter. A new type of anchor has been developed which is claimed to assure the fixity of the seadrome. From the anchoring buoy a connecting cable attaches to the seadrome. If wind and wave pressures on the latter should reach beyond those fixed as safe operating limits, the connecting cable would be released and relieve the anchoring system of stress. The seadrome will move with the wind, being regulated through a system of winches so that planes can always land into the wind.

The building of the seadrome is being carried out by the Armstrong Seadrome Development Company, Wilmington, Del., with Henry J. Gielow, Inc., naval architects, New York City, as consulting engineers.

Solving Oil Field Waste-Disposal Problems

Twenty Oil Producers Co-operate in Building Plant to Prevent Water Pollution by Reclaiming Oil Waste—Salt Water Conveyed 16 Miles to the Ocean

THE SANTA FE Springs Waste Water Disposal Company is a non-profit co-operative organization formed by twenty oil-producing companies to dispose of the salt water brought to the surface in oil well operation at Santa Fe Springs, Calif. Because of the danger of polluting underground waters used for irrigation, this waste cannot be discharged into surface channels. The most expensive item involved was the construction of a 16-mile pipe line to convey salt water to the ocean, but interest centers chiefly in the plant of novel design in which oil and sediment are removed from the salt water before it goes into the discharge line. Waste water enters this plant with an oil content of 400 to 500 p.p.m. and when discharged contains only about 12 p.p.m.

Experimental Studies—This is the third co-operative oil waste-disposal system to be established in southern California. Before the design for the separation plant was adopted, experiments were conducted for about three months to carry determinations further than had been done on previous work. The experiments were made in a wood trough, 1 ft. wide, 5 ft. deep and 110 ft. long, having glass windows in the sides through which to observe the effects of adding baffles and curtain walls at varying locations.

The experimental work showed that velocities of more than 1 ft. per minute would carry off oil that was present in the emulsified state—that is, particles which are so minute that gravity, unaided, will not bring them to the surface and they tend to remain in suspension. On the other hand, with velocities of less than ½ ft. per minute, most of the actual flow would take place in a thin stratum near the top, the rate of flow being almost nothing for the remainder of the depth.

The removal of sediment and oil that floated on the surface involved comparatively simple processes, but finding some means of separating this emulsified oil in an inexpensive way was more difficult. The emulsified oil amounts to less than ½ per cent of the oil contaminant, but its removal requires a disproportionately large expenditure. In fact, about one-half the area of the plant (all of that portion below the riffle) is devoted to this function.

The process employed is an inexpensive adaptation of the flotation principle developed in the course of the experimental studies. It was found that in a tank the surface of which was free from any film of oil, if the minute particles held in suspension could be brought to the surface, they would there break up into a thin iridescent film that would spread over the surface. To

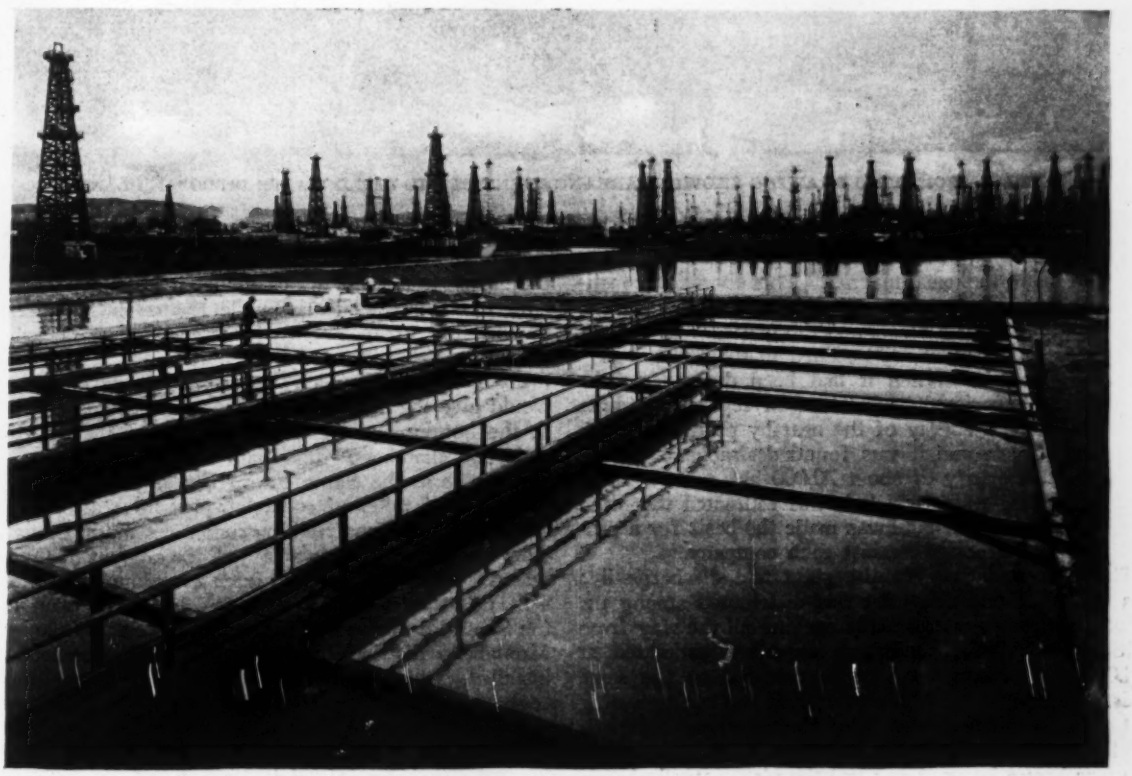


FIG. 1—LOWER END OF OIL WASTE-DISPOSAL PLANT
Emergency waste water storage basin in right background. Sludge disposal basin at left.

take advantage of this tendency, the plant was designed so that after the floating oil had been entirely removed, the apparently clear waste water was passed in a thin stream over a riffled ramp. The riffles were so constructed that after passing over each successive ridge the water fell to the surface of the concrete ramp below, thus receiving a maximum aeration.

After this treatment it was found that with a low velocity in the compartments below the riffle the suspended particles rose to the surface slowly but continuously and collected as a thin scum which could be readily skimmed off in the usual manner. This operation constitutes perhaps the most interesting feature of the process. The organization as a whole and the general sequence of operations in the plant are outlined in the following:

Cost Allocation—When it had been decided on the basis of the experiments what kind of separation works would be built, a survey of the near-by producing companies was made and it was found desirable to erect a plant with a capacity of about 70,000 bbl. per 24 hours. The amount of waste which it was estimated that each company would contribute was made the basis for a proportional levy assessed against each company.

The estimated cost for the plant and discharge line was $450,690, and this total was distributed among the twenty companies, assessments ranging all the way from $118 to $175,995. Operating expenses, estimated at $18,000 per anuum, were to be assessed on the same basis. It appears now, however, that the net operating cost will be much lower than the estimate. Experimental work was begun in February, 1928. Construction was begun last summer and the plant actually began operations in February, 1929.

Description of Plant—The plant itself consists chiefly of a series of rectangular concrete tanks built below ground level, designed and arranged to use successively, by gravity flow only, processes of aeration, sedimentation, preliminary oil skimming, re-aeration and agitation by means of a riffle overflow, secondary oil skimming and, finally, filtering through a layer of excelsior at the entrance to the discharge line which takes the effluent to the ocean.

The main plant—that is, the central portion comprising the connected compartments for sedimentation and skimming—is divided into two separate units by a longitudinal partition wall which makes it possible to operate either half independently while the other half is shut down. The arrangement of baffle and curtain walls is shown in the accompanying illustrations, the arrangement being that which experimental work indicated would give the maximum efficiency in bringing sediment to the bottom and oil to the surface of the successive collection chambers. The plant was located as centrally as possible in the Santa Fe district and required laying only about 6 miles of collection pipe lines in order that all twenty of the contributing companies might be served. These pipe lines vary in size with the amount of the estimated contribution, ranging from a minimum diameter of 4 in. up to an 8-in. main that delivers to the plant from the Santa Fe Springs district and an 11-in. line from the Montabello district. When this collection system was installed, disk meters were put in on the property of each contributor at the point where delivery was made to the collection system. Because of the amount of rotary-drill mud and obstructions such as rope, pieces of clothing, etc., that got into the pipes, the disk meters were removed and measuring devices of the notch type were substituted. Thus the oil and water waste on each con-

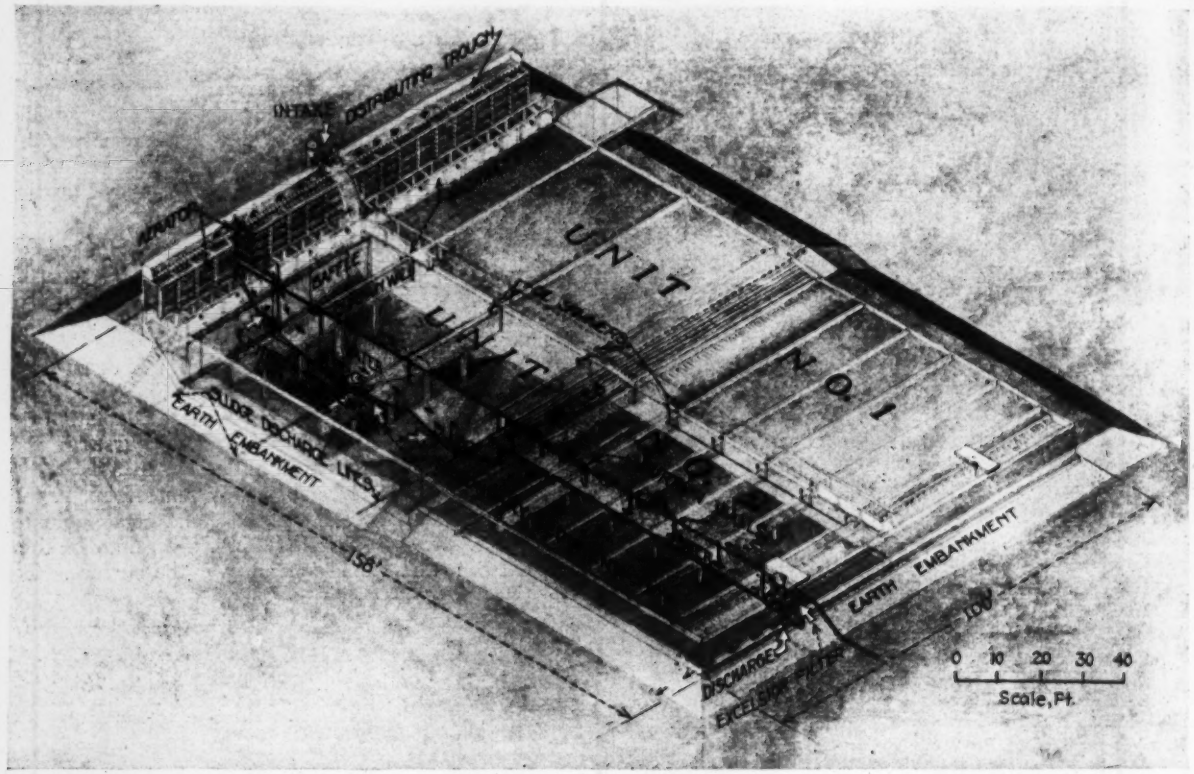


FIG. 2—ISOMETRIC DRAWING SHOWING ARRANGEMENT OF OIL FIELD WASTE DISPOSAL PLANT

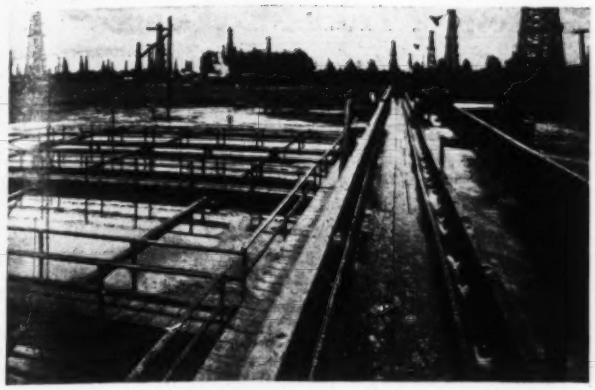


FIG. 3—DISTRIBUTION TROUGH AT INLET
Vertical slide doors effect uniform distribution across entire 100-ft. width of plant.

tributing property is collected in a gravity drainage system and is discharged through a V-notch weir into a sump, whence each company pumps it under such pressure as may be required into the collection lines leading to the central plant.

At the plant the 8-in. main terminates in a riser discharging into a trough 1x2½ ft. in section which extends entirely across the upper end of the plant. By means of openings with vertical-slide doors on one side of the trough there is thus effected a uniform distribution across the entire 100-ft. width of the plant. This trough was built about 8 ft. above the tops of the concrete separating basins, so that before entering the first basin the influent would be given its first aeration by dropping through a series of horizontal racks or grillages made up of parallel strips of wood. These grillages are 1 ft. apart, and the strips in each one are at right angles to those in the preceding grillage, thus securing the maximum effect in breaking up the lumps of slurry as they drop into the first settling basin, which is located directly below.

This basin accumulates about 99 per cent of the sediment. To facilitate rapid settling here one side wall was inclined so that the greater part of the solids, as they settle, slide down this submerged concrete face. This design has been fond to be effective in securing a maximum sedimentation.

Floating oil is removed from this basin through a

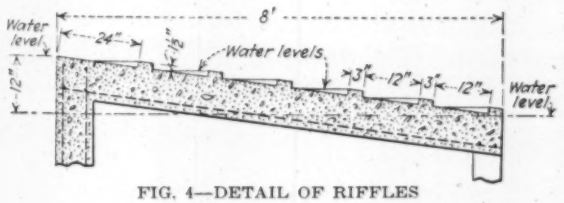


FIG. 4—DETAIL OF RIFFLES

"swing pipe," a skimming device universally used in oil fields, consisting of an outlet pipe the upper end of which is adjustable to maintain the desired level. A simple and effective scheme for supporting these pipes consists of a plank with a hole near its center, laid on top of the concrete wall at one corner of the basin. A chain passed through the hole has its lower end attached to the free end of the swing pipe. The level is varied by raising or lowering the chain and leaving it supported at the desired level by a nail thrust through a link just above the hole in the plank.

The sediment, which consists very largely of slurry or rotary-drill mud, has thus far always been sluiced out without the necessity of unwatering the basins. In other words, simply opening the valves in the 4-in. pipes that drain from the low points in each sludge pit has been sufficient to carry the accumulation of sediment into an adjoining sump. From this sump the slurry is delivered through centrifugal pumps to a pit near by. Surplus water that rises to the surface in this pit is pumped into the influent to the plant.

Oil and the water that flows out with it through the skimming pipes are collected in a concrete basin operated as a gravity separator—that is, by varying the levels of swing pipe outlets, one from the bottom and one from the top, the level of both oil and water is controlled as desired. Water goes back into the plant intake and oil is pumped into storage tanks near by. Based on the short operating period thus far, it would appear that oil recoveries ranging from 200 to 400 bbl. of oil per day will be made. Although the quality of this oil is more

FIG. 5—CLOSE VIEW OF THE AERATION RIFFLE IN SERVICE
Oil spot illustrates breaking of particles on clear surface. The riffle expedites this action.

or less variable, it is estimated that it may bring from 60 to 75c. per barrel.

Returning now to the sequence of operations in the flow through the plant, after sediment is removed and floating oil is skimmed off, the waste water is passed over a riffle that cuts entirely across the plant at right angles to the direction of flow. At this stage in the process the waste appears to be free from oil, but in reality there is an emulsified oil content of 20 to 30 p.p.m. Although this degree of purity is well below government requirement, it was found that in time it would cause a greasy, waxlike crust to collect along the water line of any object projecting above the surface. Therefore removal of this objectionable residue was desirable.

The action of the riffle on the small oil particles is to bring them to the surface, where they break and spread, thus losing their emulsified character and becoming merely floating oil. This process continues in the several basins below the riffle, successively lesser quantities being collected and skimmed off by swing pipes at the several curtain walls interposed between this point and the discharge into the collecting trough at the outlet end of the plant.

In the collection trough at the outlet the effluent is finally filtered through a 4-ft. layer of excelsior. The

excelsior is retained on a timber grating near the bottom of the trough, through which it is prevented from escaping into the discharge by a screen of ¼-in. mesh. It is prevented from floating up in the trough by a 6x6-wire mesh.

The discharge line from the plant is a vitrified clay pipe 81,000 ft. long emptying into the ocean at Seal Beach. The pipe varies in diameter from 18 to 24 in. and has a total drop from plant to sea level of 125 ft.

To provide a temporary receptacle for the salt water in case of any break in the discharge line, a 220,000-bbl. reservoir was constructed close to the plant by throwing up earth embankments around a central excavation and lining the depression with asphaltum. Valves at the discharge end of the plant are so arranged that in any emergency the effluent can be made to flow by gravity into this reservoir.

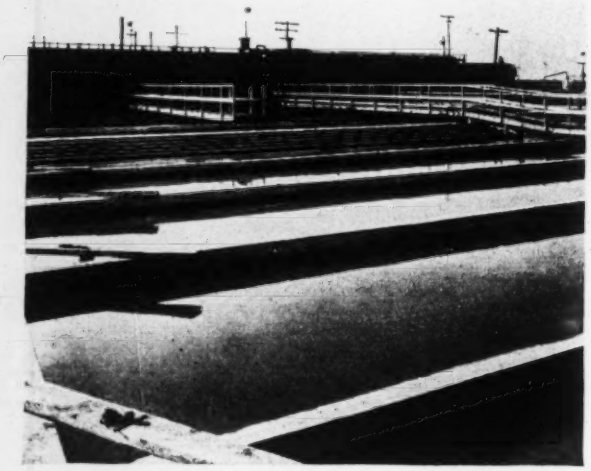


FIG. 6—VIEW ACROSS PLANT FROM DISCHARGE END
No water passing over riffle in this view. In left foreground chain and nail are typical of adjustable swing pipe support.

Operations have been so systematized that one man can run the entire plant. An hourly log is maintained to keep a close check on the quantity of flow and also on the oil and sediment content. The frequency of blowing out sludge and the adjustment of the skimming pipes depend upon the flow into the plant and the percentage of mud and oil contaminants.

C. C. Scharpenberg, of the Standard Oil Company, is president, and H. L. Emerson, of the General Petroleum Company, is secretary of the Santa Fe Springs Waste Water Disposal Company. Mr. Scharpenberg was also chairman of the engineering committee in charge of the design and construction of the disposal plant. Operation is under the personal direction of R. M. Fullaway, who has been working on the project since the experimental trough was built.

Volumes of Retaining Walls

In the article entitled "Simplified Method of Calculating Volumes of Retaining Walls," published on page 765 of last week's issue, a typographical error appeared in the formula designated as Case 2. The correct formula is as follows:

Case 2. For walls with two faces battered.

This formula may be used for calculating the volumes of earth dikes and dams and earth excavation as well as volumes of concrete walls

$$V = \frac{L}{27}\left[\frac{W(H+h)}{2} + \frac{(S_1+S_2)(H^2+Hh+h^2)}{6S_1S_2}\right]$$

Tests of Truck-Mixer Concrete

By A. R. Hirst
Consulting Engineer, Madison, Wis.

THREE test runs of a truck mixer (Bickel patents) were conducted at Columbus, Ohio, in December, 1928, to determine the effect of time of mixing and number of revolutions on degree of slump and compressive strength. In making the tests the writer was aided by Prof. J. R. Shank, Engineering Experiment Station, Ohio State University, who tested the materials and crushed the cylinders following the standard methods laid down for such work by the American Society for Testing Materials.

The same materials were used throughout. Due to lack of proper charging arrangements, about three minutes was consumed in loading each 2-yd. batch. The revolutions while loading were not counted as mixing revolutions. An effort was made to gage the water so that the mixed concrete would have a slump of 2 in., but due to rain and other causes the first test batch was too wet and the second and third batches were too dry. The first batch was mixed with the truck running around the streets. The last two were revolved with the truck standing still. The speed was varied from about 5 r.p.m. for the lower numbers of revolutions to as high as 15 r.p.m. for the revolutions above 40.

A check was made of the completeness of discharge of the mixed concrete by weighing the truck on an ordinary platform scale (*a*) before loading, (*b*) when loaded, and (*c*) when discharged. The weights were as follows: (*a*) 12,180 lb., (*b*) 20,000 lb. and (*c*) 12,200 lb.

The results of the strength and slump tests are given in the accompanying tabulations. They appear to warrant the following conclusions:

1. That the speed of revolution, within the possible limits of the device, does not greatly influence the compressive strength of the concrete.

RESULTS OF STRENGTH AND SLUMP TESTS

Total Revolutions	Mixing Time Min.	Mixing Time Sec.	Slump, In.	No. of Cylinders	Lb. Per Sq. In. at 28 Days
First Test* Water 0.66, Cement 1.00, Sand 1.93, Gravel 2.76					
10	3	20	10	6	4,170
20	6	5	7	5	4,270
40	11	35	6	5	4,560
100	19	0	6	5	4,690
200	54	20	5	5	4,750
Average					4,480
Second Test† Water 0.57, Cement 1, Sand 1.93, Gravel 3.22					
10	2	40	0	5	5,920
20	5	10	¼	5	5,660
35	8	45	2	5	4,450
100	13	45	1¼	5	5,100
200	22	25	¾	5	5,190
Average					5,275
Third Test‡ Water 0.76, Cement 1, Sand 2.91, Gravel 5.52					
10	2	30	½	5	3,150
20	5	0	½	5	3,340
40	15	0	0	5	3,390
100	31	40	¾	5	3,580
200	40	0	1	5	3,730
Average					3,620

*Note the decrease in the slump and the increase in the strength with the increasing number of revolutions. This was the only batch of the three test batches to which no water was added after the original charging.

†After the first two mixings, 5 gal. of water was added, making the final proportions as above. Note the increased slump and the lower compressive values due to this addition of water.

‡Measured water was added from time to time as the mixing proceeded, as this mix was constantly too dry. Final water was as shown. The comparatively low strength of the cylinders made from the first three very dry runs was undoubtedly largely due to voids in the cylinders.

2. That very dry concrete can be thoroughly mixed and completely discharged.

3. That, in general, the compressive strength of the concrete increases with the number of revolutions of the cylinder.

4. That the slump of the concrete decreases with the number of revolutions, if there is no water added during the continued mixing.

5. That there is no reduction in the compressive strength due to long retention in the cylinder up to at least the time of initial set of the cement. (Due to slowness of the testing operations, each batch remained in the cylinder well over two hours.)

Some Recent Points Decided in Engineering Law

REVIEWED BY HERBERT BRAASCH
Attorney at Law

DECISIONS reached in cases tried in the higher federal courts and in the state supreme courts are summarized in these articles appearing from time to time in *Engineering News-Record*. The last group will be found in the issue of March 7, 1929, p. 388.—EDITOR.

Who Are Material-Men?

The Indiana Limestone Company sold stone to Cuthbert; Cuthbert resold it to Scott Brothers, bonded contractors on a public building. The Limestone company sought the benefit of a material-man's remedy on the bond. The suit was dismissed. It was held that only Cuthbert was a material-man, the Limestone company being too remote.—*Indiana Limestone Company vs. Cuthbert, Kansas.*

Undirected Payments Loss to Surety

The Vance Plumbing & Electric Company, on giving bond, was awarded the contract for sanitary work on the Franklin County Home. This company was already a customer of the Standard Supply Company, material-men, to whom a large sum was due on account. For this job additional purchases were made, and checks were sent for a sum exceeding these material costs. On completion, the material-man endeavored to recover the cost of the materials used in the Franklin County job out of the bond.

The bonding company's reply that payment had already been made was denied by the court. A debtor owing two or more debts to the same creditor and making a payment may, at the same time, direct its application to any one of the debts. This right is lost if the particular application is not directed at the time of payment, and the creditor may then apply the payment to the debt he chooses. If neither debtor nor creditor acts, the law will apply it to the unsecured, or more precarious, debt. As the plumbing contractor made no specific direction, the check was properly credited to the general account. —*Standard Supply Company vs. Vance Plumbing & Electric Company, North Carolina.*

No Bond Liability for Capital Investments

A dealer supplied equipment and repair parts to a contractor on public road work. The contractor defaulted, and payment out of his bond was sought. It was held that these items, together with the labor used in effecting repairs, constituted part of the capital investment of the contractor as distinguished from material or labor which became part of the completed project, and recovery on the bond was denied.—*Montgomery vs. Southern Surety Company, Indiana.*

Equipment Removal Prohibited

During the construction of an Atlantic City convention hall disputes as to detail and payments arose between the general contractor (the Markland Company) and its subcontractor for the steel frame. The general contractor not acceding to the steel contractor's demands, the receiver of the steel contractor, who was managing the steel company's contract, stopped the work and began removing its steel-erecting equipment. The general contractor interfered, whereupon the receiver asked for an injunction restraining the general contractor from blocking such removal.

A term of the contract was that if it appeared to the Markland Company that provision for prompt performance was not being made by the steel contractor, or if he got behind in his work, the general contractor should have the right to enter and take possession of materials, tools and appliances, and that this provision was an assignment for that purpose.

The court refused the injunction, thus preventing removal of the equipment. It was held that, since the general contractor was solvent, the steel contractor or his receiver would have to bring up in the regular way the questions of title to equipment, right to its possession, and amount due under the contract, upon the completion of the work. An additional reason given by the court was that the subcontractor in his contract had also agreed to the terms imposed by the contract under which the entire project was let. This stated that equipment used in construction should remain to aid such construction.—*U. S. Fidelity & Guaranty Company vs. U. S. Steel Construction Company, New Jersey.*

Effect of Omissions in Specifications

In William Delaney's contract to plaster a New Orleans trade school "according to plans and specifications" no mention was made of several pilasters obviously requiring the cover Delaney gave them. The general contractor was allowed nothing on this item, so Delaney could claim it only as an "extra." "Extras" were required to be by written order of the city engineer, a duplicate bill being submitted and approved. This not having been done, the court disallowed the claim.

The architect eliminated certain trim, decreasing the work. The saving was held deductible from the balance due under a term of the contract. Delaney refused to do other plastering because it was not mentioned in the specifications, although it appeared on the drawings. The general contractor was allowed to deduct the cost of having this done from the money due Delaney.—*Delaney vs. John O. Chisholm & Company, Louisiana.*

Public Officer's Interest Voids Contract

The treasurer of a sanitary district in Illinois was an officer and substantial stockholder of a company taking contracts on sewer work. This company, as low bidder, was awarded a contract in the district. In a suit brought by a taxpayer the contract was held void. It was held immaterial that this officer had nothing to do with the letting of the contract, that the company receiving the award was the lowest bidder or that there had been no collusion among the bidding companies.—*Peabody vs. Sanitary District of Chicago, Illinois.*

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

Suspension Bridges Revised

Reviewed by O. H. AMMANN

Chief Engineer of Bridges,
The Port of New York Authority, New York City

A PRACTICAL TREATISE ON SUSPENSION BRIDGES. Their Design, Construction and Erection—By D. B. Steinman, M.Am. Soc.C.E., Consulting Engineer. Second Edition, Revised. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6x9 in.; pp. 299; line cuts and half tones. $5.

The second edition of Steinman's "Practical Treatise on Suspension Bridges" appears at a moment when the eyes of bridge specialists are perhaps more than ever focused on the suspension type of bridge. The unmistakable revival of this meritorious type, after having all but disappeared from the field of new construction for nearly a generation, its application to spans of unprecedented magnitude, new developments and conceptions concerning its characteristics, its theory, and its various design features, and the introduction of new or further improvement of old materials, all point to the desirability of a fuller and more up-to-date presentation of this type in our engineering literature, particularly for the guidance of the student and the young engineer. If the author has failed to bring his work to date to the fullest possible extent, it may be excused on the ground that certain developments are so recent that their treatment in a textbook might be somewhat premature, and the student must, therefore, count on supplementing his information from other current sources.

The present edition has been enlarged from 200 to 300 pages. The first 200 pages comprise practically the old edition with but slight changes. For this part of the work the reviewer refers to his notes in *Engineering News-Record*, Dec. 1, 1922, p. 1080. The new material is denoted as appendices B, C, D and E. The first two of these are devoted to a brief description of the design and construction of two recently completed suspension bridges of distinct types, namely the Florianopolis bridge which has eyebar cables and comparatively rigid stiffening trusses of variable depth, partly attached to the cables; and the Ohio River bridge at Portsmouth, O., which is a wire cable bridge of the common type with independent parallel-chord stiffening trusses. The latter bridge is typical of the majority of modern suspension bridges, which fact should serve to indicate the merits of that old, simple and graceful type of construction.

The Florianopolis stiffening trusses are called an innovation, giving the impression that the author is the originator of a stiffening truss in which the chain is utilized as part of the upper chord and the depth of which follows approximately the curve of greatest moments. The type has been applied and proposed by other engineers previously and its possibilities were thoroughly discussed by S. Sonntag in several issues of "Der Eisenbau" in 1911. In the reviewer's opinion, the claimed economy of the type over that of a rationally proportioned parallel-chord truss remains yet to be proven by competitive bidding. In comparatively flexible long span suspension bridges the greatest bending moments of the stiffening trusses vary but little for the central half of the span, and parallel chords for the trusses are without doubt the most suitable in every respect.

As indicated in the review of the author's first edition, the theory is confined principally and appropriately to the cable with independent stiffening truss, but the value of the second edition has been materially enhanced by the addition of Appendix D, which contains the so-called "Deflection Theory," which has become indepensable for the rational and economical proportioning of long-span and relatively flexible suspension bridges.

Appendix E contains a valuable tabulation of suspension bridges in chronological order, dating back as far as 1741. A bibliography on suspension bridges, as previously suggested by the reviewer, would have added to the value of the book.

Raising the Submarine S-51

ON THE BOTTOM—BY Commander Edward Ellsberg. New York: Dodd, Mead & Co. Cloth; 6x8 in.; pp. 324; Frontispiece portrait of author, many other halftones; end-paper diagram showing method of lowering pontoons to raise submarine S-51. $3.

Step by step the raising of the S-51, sunk near Block Island and for nearly a year forming the watery grave of 29 men, is here told by the navy officer in charge of the work. The story is told in a minute detail readily followed only by those intimately familiar with submarines and operations for salvaging them; yet it is so dramatic in itself and in the long fight against the fearful odds of working in 132 ft. of water, and so vividly written at every point, as to hold the reader's interest from beginning to end. This is not to say that judicious scanning and skipping is not likely to be done by all except naval and wrecking officers and men; but few that open the book and read a half dozen pages will put it aside without getting at least the gist of the whole story. The thousands who followed the recovery work on the S-51 from October to July, 1925-26, will be glad to re-read the story, couched in the concise and vivid language of the officer in charge. Rarely has there been such a combination of technical description and literary ability.

High spots in the story are restoring airtightness to the uninjured compartments of the vessel, which involved deep-sea metal cutting with a specially devised torch; improvements in the deep-sea electric light; pouring quick-setting cement to seal leaky chattering valves 130 ft. underwater; tunneling beneath the submarine amidships, through dense clay, by means of hydraulic jets; a tunnel cave-in requiring the diver then at work to force his way backward through the clay; a long, and almost baffling, weary task of sinking and attaching the pontoons with which the S-51 was floated; and finally the close escape from ruin of the whole enterprise when a special pilot somehow grounded the S-51 on Man of War Rock, a few miles from the Brooklyn Navy Yard.

One hardly knows whether to admire most the inventiveness and leadership of Commander Ellsberg or the skill and devotedness of his many helpers, especially the divers, who worked under almost inconceivable handicaps, in cramped spaces, surrounded by the dead—in

several instances staying under water far over safe time, once for more than three hours, in order to make sure of what they had gained.

The high literary character and broad and deep human appeal placed upon the volume by those who should know is attested by the fact that it was adopted for circulation by the Book of the Month Club as its May selection. If it was considered of such general appeal as this indicates surely it is bound to hold the attention of every engineer and contractor who once sets his eyes on its entrancing pages.

Concrete Bridges and Structures

REVIEWED BY E. L. ERIKSEN

Professor of Structural Engineering, Purdue University.

REINFORCED CONCRETE CONSTRUCTION: Vol. III, Bridges and Culverts. Prepared in the Extension Division of the University of Wisconsin by George A. Hool, S.B., Professor of Structural Engineering, with Chapters by A. W. Ransome, Wm. J. Titus, Albert M. Wolf, Philip Aylett and P. J. Markham, and Articles by A. C. Janni and S. W. Bowen. Second Edition. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 705; 575 line cuts and halftones. $6.

The first edition of this book was published in 1916 as Volume III of a series of books on reinforced-concrete construction and is still the outstanding and most comprehensive book on this subject.

The new edition is divided into seven parts dealing with analysis, design and construction of concrete arch bridges, girder bridges and culverts. In Part I the theory and analysis of arch action is presented both analytically and graphically. The analytical method, with the usual formulas for *H, V and M*, is handled very well and sufficiently explained so that it will be readily understood by any one who has a fundamental knowledge of the theory of structures. Examples of earth-filled symmetrical and unsymmetrical arches are worked out in detail, as well as examples of the open-spandrel type by help of influence lines. The graphical analysis or ellipse of elasticity method is presented and the author makes the statement that this method is rapid and easily applied. The presentation is scanty in detail and leaves quite a bit to be read between the lines. Some of the quantities, such as moments of the elastic weights, are in certain instances very difficult to obtain graphically to any degree of accuracy and can be obtained more accurately by a combination of graphical and analytical methods.

Chapter 9 (35 pp.) taken from Design of Symmetrical Concrete Arches, by Charles S. Whitney (*Trans.* Am. Soc. C. E.), is a very valuable addition to this book and will be of great help to engineers in the design of arches as it practically eliminates the old method of guessing at the shape of the arch ring. This chapter completes the mathematical part of the book except for a short section on three-hinged arches and box culverts.

The remainder of Part I is mostly of a descriptive nature, containing hundreds of beautifully executed illustrations covering details, construction and typical designs of reinforced-concrete arch bridges, including the three-hinged arch. This is presented in an excellent manner and makes the book one of the leading American works on concrete arch bridges.

Part II (about 60 pp.) is devoted to slab and girder bridges and contains many illustrations from practice. Part III treats the culvert pressure on pipes in ditches and the strength of pipes, summarized from an investigation made at the Iowa State College of Agriculture and Mechanical Arts and at the Engineering Experiment Station at the University of Illinois. A theoretical treatment of box culverts is also included. Part IV, written by A. W. Ransome, takes up the construction plant, including concrete mixing and distribution.

Part V, The Artistic Design of Concrete Bridges, written by Wm. J. Titus, chief engineer of the Indiana State Highway Commission, is perhaps the most outstanding and certainly one of the most interesting parts of the book. Aided by a number of illustrations, the author analyzes in detail the aesthetic elements of a bridge and points out very clearly the good as well as the bad features of bridge design and ornamentation.

Part VI, on Construction in Detail, written by A. M. Wolf, treats field methods, such as plant layouts and the different methods of constructing arch centers used for some of the larger structures built in this country.

Part VII, European Concrete Bridges, written by Philip Aylett and P. J. Markham, is mostly a comparison of American and European concrete bridges. It contains reproductions of photographs illustrating the lightness and elegance of some of the outstanding European bridges, especially in France and Switzerland.

The Story of Engineering, Old and New

WHAT ENGINEERS DO: An Outline of Construction—By Walter D. Binger, M.Am.Soc.C.E. New York: W. W. Norton Co. Cloth; 6x9 in.; pp. 259; pen-and-ink sketches. $2.75.

The history of civil engineering is a history of civilization. Civil engineering is a complex subject difficult to present in non-technical terms readily understood by the layman. Yet Mr. Binger in a single volume has not only explained this branch of engineering in a simple, interesting and understandable manner but has gone back into the ages to show the present elaboration of engineering principles discovered in ancient times. Vitruvius and his "Ten Books of Architecture" (25 B.C.) are freely referred to in this comparison between the old and new. And wisely the author refrains from covering too wide a scope in his presentation of a many-sided subject. He confines the book to foundations, surveying, hydraulics, water supply and flood control, structural design and materials, ending with a chapter on the engineer as viewed from the human side. Basic principles only of each subject are presented, at no time using technical language or resorting to highly imaginative comparisons or examples.

Primarily the work was written for the layman, but the technical reader will find interest in the many historical sketches and comparisons. In this day of pure water supply programs and developments it is interesting to note that Vitruvius tested a water supply of unknown source or doubtful purity by killing several cattle found living near the supply and examining their livers. He maintained that if the cattle's livers were sound and healthy that the water they had been drinking was pure and fit for human consumption. And speaking further of water supply problems the author comments that Pindar's statement that "The chief thing is water," made about 500 B.C., has held down through the ages to our present day. Early bridge, building and highway construction provides further material for interesting discussion.

The last chapter is devoted to the men who do the work—the engineers. It is a summary of the ethics of

the engineering profession as applied to construction work. The engineer's responsibility for the safety of the work is shown to a degree that approaches a highly desirable ideal rather than actuality in modern construction. And the frequent question of "Why is an engineer?" may be answered with the author's closing words: "Those who enjoy physical accomplishment, who derive pleasure from close application to one piece of work, and, after it has been done well, look forward to commencing another quite different, will always find a reward in civil engineering and construction."

Supplying the Allied Armies

THE ALLIED ARMIES UNDER MARSHALL FOCH in the Franco-Belgian Theater of Operations: Report of the Military Board of Allied Supply—[In English and French, on facing pages.] Two volumes in cloth; 6x9 in.; pp. 577, 1173; illustrated. Also portfolio, in cloth, of maps, etc., same size. $1.25 for Vol. I; price of Vol. II not given; portfolio, $3.75; to be purchased from Superintendent of Documents, Washington, D. C.

A very complete picture of the task of supplying the allied armies in France is given in this report of the Military Board of Allied Supplies. Nowhere else is there brought together such a compilation of data on the vast undertaking of keeping food, ammunition and miscellaneous equipment of all kinds supplied to the army as is given in these volumes and their charts and maps. As Brig. Gen. Charles G. Dawes states in his foreword: "These volumes are unique in the literature of war. It is the one great official statement of the allied armies under Marshal Foch operating in the Franco-Belgian theater of operations."

Briefly stated in the Preface, the report concerns the organization, operations and decisions of the Military Board of Allied Supplies, but that statement gives no indication of the fact that the volumes are a historical record of the many activities of the allied armies back of the front line, activities seldom written because of their lack of picturesqueness. Engineers had a large part in this work. On them was placed responsibility for the construction of ports and storage depots, standard- and narrow-gage railway lines, roads, ammunition depots and railheads.

By printing the report in both French and English, on facing pages, it is made readily available to all who may be interested in France and to many in other countries who do not read English readily, if at all.

By a Scotch Cleansing Superintendent

MODERN PUBLIC CLEANSING PRACTICE: Its Principles and Problems—By A. L. Thomson, M.Inst.M.&C.E., M.R.S.I., Cleansing Superintendent to the Motherwell & Wishaw Burgh Council. Foreword by Professor Moncur, M.Inst.C.E. London: The Sanitary Publishing Co., Ltd. Cloth; 5x7½ in.; pp. 260; folding plates and 61 illustrations. 11s.

Dustbin and cleansing department are terms of general acceptance in Great Britain. The first, with its implications, suggests one of the great differences between British and American methods of dry-refuse disposal, in the use of a single house receptacle for garbage, ashes and rubbish, and a single system of collection, whereas in America two receptacles and collections are common and three not infrequent. The second term, cleansing department, is more an accident of terminology than significant of British and American contrasts, except as its general use in England, Wales and Scotland suggests a more thorough departmentalizing there than here of the services rendered.

Mr. Thomson's book is trebly welcome: It brings to date British cleansing practice; it covers not only the collection and disposal of all city refuse except sewage but also street cleaning, watering and snow removal; and last to be mentioned but not least in importance, it is written by an experienced cleansing superintendent who is an engineer. Despite the inevitable differences between conditions and methods in the United States and Great Britain, the book promises to be highly useful and suggestive here; in Great Britain it must be still more so.

Mr. Thomson's Introduction consists of an interesting historical sketch of refuse disposal, from the days of the midden of prehistoric ages to the comparatively recent midden of British cities and the dustbin of several decades past. His chapter on cleansing and public health is well balanced; the one on the cleansing official is admirable. From the British viewpoint, the discussion of house storage of refuse is all that could be asked, but the author's remarks on refuse separation in the United States show a lack of knowledge of American governing conditions. Collection and transportation of refuse are well handled.

Chapters of particular interest deal with towns' refuse as a manure, including pulverization to that end; land reclamation, including a reference to our "sanitary fills" and similar ones in England, particularly at Bradford; screening and salvage; incineration and power production; utilization of recovered materials, including the extensive use of clinker for "paving slabs."

There are chapters on street cleaning, gritting and snow removal; the horse; educational and publicity work; and management, records, statistics and costing. In their proper place, rats and insects at refuse dumps and also disposal at sea are considered. Tabular comparisons of practice in British cities are a good feature of the book. Altogether, the volume is a notable addition to books on municipal administration.

Spray Painting and Lacquering

PRACTICAL RAILWAY PAINTING AND LACQUERING—By H. Hengeveld, Master Painter, Atlantic Coast Line Railroad; C. P. Disney, Bridge Engineer, Canadian National Railways, and William J. Miskella, M.E., Director, Finishing Research Laboratories, Inc. [Practical Finishing Series, Vol. IV.] New York and London: Simmons-Boardman Publishing Co. Bound; 6¼x9¼ in.; pp. 267; 164 illustrations. $3.50.

Lacquers and paint sprays have revolutionized commercial painting methods and ideas. The revolution started with the development of paint sprays using ordinary oil paint and reached its climax in the development of commercial lacquers. Both the lacquers and sprays brought new problems, and being new developments information in a concise form concerning their use has been hard to find. This book was written to meet the demand for such information.

Primarily the book deals with railroad painting problems but the latter cover so wide a field that anyone having painting work where quality production is necessary will find the book of value. The subject matter ranges from the coarse work of bridge painting through locomotive and box car painting to the fine finishing work on the interior of railway coaches and electric railway cars. Four parts of the book are given over to these specific painting problems. The fifth part is devoted to general information. It includes descriptions of spraying equipment and accessories, lacquer and spray gun troubles and their remedies, methods of handling and storing paints and lacquers with safety, modern testing methods, and the use of scaffolding.

Publications Received

THE BUILDING TRADE EMPLOYERS ASSOCIATION OF POLAND has begun publishing an "official organ" entitled *Przeglad Budowlany* (Building Review). It is divided into two parts, one economic, the other technical. Under the former, Henryk Martens, president of the association, writes of The Essentials of the Building Industry. A brief synopsis of each article is given in French, German and English.

A BUILDING CODE SYMPOSIUM has been published by the American Institute of Steel Construction, 200 Madison Ave., New York City. The booklet contains statements by Arthur Tappan North, architect, New York; Rudolph P. Miller, consulting engineer, New York; Frank Burton, consulting engineer, Detroit; Fermore Spencer Cannon, architect, Indianapolis. It also includes the 1925 report of the Building Code Committee of the United States Department of Commerce.

WAR SERVICES of officers and former officers of the Corps of Engineers, U. S. Army, are listed in *Occasional Papers* No. 68 of the Engineers School, U. S. Army, Washington, D. C. A tabulation of officers who received the Distinguished Service Cross and the Distinguished Service Medal also is included. Only the records of officers or former officers of the regular army are included in this listing. At some future date the Engineers School hopes to publish a similar listing of all the officers who were commissioned in the Engineer Corps for the period of the war.

CANAL AND WATER TUNNELS is the English equivalent of the title of a pamphlet by Shu-T'ien Li, Ph.D. (Eng.), a member and executive secretary of the North China River Commission, Tientsin, China. The pamphlet is in Chinese, but the author has prefixed to it a few pages in English classifying tunnels by purposes for which built, and describing some of the most notable tunnels in various parts of the world, grouped under the heads canal, water supply, sewer, irrigation, drainage, gold searching, water power, and power plant.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

ACCELERATION STRESSES IN HOISTING ROPES—By G. P. Boomsliter, Professor of Mechanics. Morgantown, W. Va.: Director of Engineering Experiment Station, West Virginia University. Paper; 6x9 in.; pp. 79; illustrations and tables.

AIRPLANE STRUCTURES—By A. S. Niles, Professor of Aeronautics Engineering, Leland Stanford Jr. University, and Joseph S. Newell, Assistant Professor of Structural Engineering, Massachusetts Institute of Technology. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6x9 in.; pp. 413; line cuts. $5.

AMERICAN ROAD BUILDERS' ASSOCIATION PROCEEDINGS—1929 Convention—Edited by Charles M. Upham; Associate Editor, Louise Wynne. Washington, D. C.: American Road Builders' Association, National Press Building. Bound; 6x9 in.; pp. 582, illustrated. $5.

APPLICATION OF TRIGONOMETRIC SERIES TO CABLE STRESS ANALYSIS IN SUSPENSION BRIDGES—By George C. Priester, Associate Professor of Mathematics and Mechanics, University of Minnesota. Engineering Research Bulletin No. 12. Ann Arbor: Director, Department of Engineering Research, University of Michigan. Paper; 6x9 in.; pp. 50; 17 line cuts. $1.

BLUEPRINT READING: A Problem Text—By W. W. Sturtevant, Instructor of Mechanical Drawing, South High School, Minneapolis, Minn. First Edition. New York and London: McGraw-Hill Book Co. Paper; 9x11 in.; pp. 135; 64 plates. $1.50.
One of the "McGraw-Hill Vocational Texts," "based on the belief that making the drawing is one of the surest ways to teach the pupil to read them, but that the best results can be obtained by eliminating from the course offered the mechanics much that is of value only to the draftsman."

BUILDING ESTIMATORS' DATA BOOK—By Charles F. Dingman, Architectural Engineer. First Edition. New York and London: McGraw-Hill Book Co. Bound; 4x7 in.; 159 line cuts and tables. $2.50.

BUS FACTS FOR 1929: A Publication of Facts and Figures of the Motor Bus Industry as of January 1, 1929—Compiled and published by the National Motor Bus Division, American Automobile Association, Mills Building, Washington, D. C. Paper; 6x9 in.; pp. 47; illustrations and folding map.

THE CONSTRUCTION OF VITRIFIED BRICK PAVEMENTS, Including Recommended Specifications—National Paving Brick Manufacturers Association, Cleveland, O. Flexible; 6x9 in.; pp. 92; illustrated.

DESIGN AND CONTROL OF CONCRETE MIXTURES—Third edition, January, 1929. Chicago, Ill.: Portland Cement Association, 33 W. Grand Ave. Paper; 6x9 in.; pp. 71, illustrated.
Has proved useful in carrying the water-cement ratio theory into field practice. In the new edition a specification for concrete based on the 1928 building code regulation of the American Concrete Institute is included. The book also gives the A.S.T.M. field tests to control concrete besides information on high early strength concrete and water-tight concrete made with standard portland cement.

ECONOMICS OF HIGHWAY BRIDGE TYPES—By C. B. McCullough, B.S., L.L.B., C.E. Chicago: Gillette Publishing Co. Cloth; 6x9 in.; pp. 246; illustrated. $5.

ENGINEERING FOR MASONRY DAMS—By William Pitcher Creager, M.Am.Soc.C.E. Second Edition. New York and London: John Wiley & Sons, Inc. Cloth; 6x9 in.; pp. 294; 116 illustrations and folding plates. $4.

EXZENTRISCH BEANSPRUCHTE SAULAN VERSUCHE mit Holzsaulen Querschnittsbmessung—With an English Summary—Von A. Ostenfeld, Polyteknisk Laereanstalts Laboratorium for Bygningsstatik. Kobenhavn: Danmarks Naturvidenskabelige Samfund. Paper; 7x10 in.; pp. 73; 21 line cuts. Kr. 3.
Takes up eccentrically-loaded columns, particularly a series of experiments with wood columns, both square and circular.

THE FAILURE OF PLAIN AND SPIRALLY REINFORCED CONCRETE IN COMPRESSION—By Frank E. Richart, Research Associate Professor of Theoretical and Applied Mechanics, Anton Brandtzaeg, Graduate Student in Theoretical and Applied Mechanics (President, A/S, Betongbygg, Trondhjem, Norway), and Rex L. Brown, Research Associate in Theoretical and Applied Mechanics. Urbana: University of Illinois Engineering Experiment Station. Paper; 6x9 in.; pp. 74; illustrations and tables. 40c.
Deals with an investigation of the action of concrete under compressive stresses applied in one or more directions. A part of the investigation has already been reported in Bulletin 185 of the Engineering Experiment Station, which contains the results of tests of concrete cylinders subjected to combined stresses applied by means of hydraulic pressure. The present bulletin contains the results of a closely allied series of tests on short columns of cylinders of plain or spirally reinforced concrete.

HANDBUCH DER NEUEN STRASSENBAUWEISEN mit Bitumen, Teer und Portlandzement als Bindemittel—Von W. Reiner, Oberbaurat A.D., Beratender Ingenieur. Berlin: Julius Springer. Bound; 7x10 in.; pp. 400; 216 line cuts and halftones. 30.5 marks.

HISTORY OF MANUFACTURES IN THE UNITED STATES—Volume I, 1607-1860—By Victor S. Clark. 1929 Edition. Published for the Carnegie Institution of Washington by the McGraw-Hill Book Co., Inc., New York and London. Cloth; 7x10 in.; pp. 607; 7 plates. To be completed this year by Vol. II and III; sold only in completed sets, $15.

A HISTORY OF MECHANICAL INVENTIONS—By Abbott Payson Usher, Associate Professor of Economics, Harvard University. New York and London: McGraw-Hill Book Co. Cloth; 6½x9½ in.; pp. 401; 148 illustrations. $5.

L'ALIMENTATION EN EAU POTABLE AUX PAYS-BAS—Par W. F. J. W. Krul, Directeur, et F. A. Liefrinck, Ingenieur du Bureau d'Etat pour l'Alimentation en Eau potable. La Haye [The Hague] 'S-Gravenhage [The Hague]. Holland: Government Bureau for Water Supply. Paper; 7x10 in.; pp. 45; 18 maps, diagrams and halftones.
A description of the public water supplies of Holland (The Low Counties), based largely on material gathered during a tour of hygienists, in 1924, but with statistics of later date.

MATTHEW MURRAY—Pioneer Engineer. Record from 1765 to 1826—Edited by E. Kilburn Scott, A.M.Inst.C.E. Leeds: Edwin Jowett, Ltd., Park St. Paper; 5½x8½ in.; pp. 132; illustrated. 2/6.

NOUVELLES ETUDES SUR LA CHALEUR—Par Ch. Roszak, Professeur a l'Ecole Centrale des Arts et Manufactures, Membre de la Commission Centrale des Machines a vapeur, et M. Véron, Ingenieur E.C.P., Repetiteur a l'Ecole Centrale des Arts et Manufactures—Preface de L. Guillet, Membre de l'Institut. Paris: Dunod, 92 rue Bonaparte. Paper; 7x10 in.; pp. 752; 78 figures in the text. Paper, 220 francs; bound, 226 francs.
These New Studies on Heat go into both the theory and practice of heat (from steam), its generation, transmission and use. Furnaces and boilers, the heating of buildings by isolated and also by central plants are taken up. American practice as to boilers and central heating are considered.

OPERATING COST STATISTICS OF AUTOMOBILES AND TRUCKS—By T. R. Agg, Highway Engineer, Iowa Engineering Experiment Station, and Harold S. Carter, Professor of Civil Engineering, South Dakota State College. Ames, Iowa: Engineering Experiment Station, Iowa State College. Paper; 6x9 in.; pp. 51; line cuts.

PRACTICAL OFFICE SUPERVISION—By Glenn L. Gardiner. New York and London: McGraw-Hill Book Co. Cloth; 6x8 in.; pp. 295. $3.
From the Preface: "The need which the author is ambitious to supply in this volume is rather for a presentation of those fundamentals of good supervision and management that every office supervisor should practice in winning the loyalty, good will, co-operation, whole-hearted interest and best efforts of his subordinates."

RISSBILDUNG IM BETONBAU—Von Erik Grossmann. Hannover: Verlags-Gesellschaft m.b.H. Paper; 6x9 in.; pp. 56. 2 Rm.

SEVEN PLACE NATURAL TRIGONOMETRICAL FUNCTIONS: Together with Many Miscellaneous Tables and Appendices on the Adjustment of the Engineer's Transit and Level, Area Computation, Vertical Curves, Simple Curves, and Determination of Latitude, Longitude and Azimuth—By Howard Chapin Ives, C.E. New York: John Wiley & Sons. London: Chapman & Hall. Flexible; 4½x7 in.; pp. 222; 20 line cuts. $2.50.
Rightly characterized in the preface as a "compact field and office book" (about 4x7x½ in.). The author calls special attention to "Table XV as likely to be of great service"; Trigonometric Formulas, Solution of Right and Oblique Angles. (10 pp.)

SIX-PLACE TABLES—With explanatory notes by Edward S. Allen, Associate Professor of Mathematics, Iowa State College. Third Edison. New York and London: McGraw-Hill Book Co. Bound; 4x7 in.; pp. 167; $1.50.

The first edition appeared in 1922. Considerable additions were made in the edition of 1925. As to the present edition, the Preface states: "The chief improvements in this edition affect the tables of natural trigonometric functions. The values of secant and cosecant have been added. All functions are given correct to six decimal places, in order that as accurate computation be possible with these tables as with the logarithms. Tables for conversion between radians and degrees are included for the first time, and such errors as have been noted in the preceding edition have been corrected."

UNION SCALES OF WAGES AND HOURS OF LABOR, 1927-1928—By U. S. Department of Labor and Bureau of Labor Statistics. Supplement to Bulletin No. 457. Paper; 6x9 in.; pp. 169. 25c. from Superintendent of Documents, Washington, D. C.

ZUGBILDUNGSKOSTEN, ZUGFORDERKOSTEN UND IHRE WECHSELBEZIEHUNGEN—Von G. Capelle, Nordhausen, Dr.-Ing. A. Baumann und Dr.-Ing. R. Feindler, Berlin. Berlin, S.14: Guido Hackebeil, A.-G. Paper; 6x8 in.; pp. 142; 68 line cuts and folding plates. 3 marks.

Letters to the Editor

Determining Free Moisture in Sand

Sir—In your issue of Feb. 14, 1929, p. 285, Mr. Dunagan comments on my previous letter of Dec. 27, 1928, p. 996 which referred to his article in the issue of Nov. 15, 1928, p. 738. Mr. Dunagan states that absorption of aggregates in his section does not exceed 0.6 per cent. In Ohio sands, this percentage ranges to as high as 2½ per cent, a high figure when an error of 1 per cent in the value used as the absorption of the aggregates may cause a change in the cement content of a sack or more per cubic yard. The wetter and richer the mix, the greater will be the change.

We have recently devised a method for determining free moisture in aggregates that has proved simple and rapid. The apparatus required consists of a balance of 3 kg. capacity, sensitive to the nearest gram and equipped with tare beam; also, two ordinary metal buckets of 10 and 1 qt. capacity respectively. The 10-qt. bucket is filled about two-thirds full of water. The 1-qt. bucket is also filled with water and hung from the balance so that its rim is just submerged in the water in the larger bucket, after which the weight on the tare beam is adjusted so that the apparatus is balanced.

Next the amount of sand is determined which, when weighed submerged in the small bucket, will just balance a given size weight, say 1,000 grams. This will be 1,600 to 1,800 grams of damp sand depending on the amount of moisture present and the value of the apparent specific gravity of sand. In practice, after the apparatus is balanced the small bucket is removed and partly emptied. About 1,500 grams of sand is added through a tube (about 2 in in diameter and 12 in. long with funnel top), placing the bottom end of tube on the bucket bottom and raising it slowly as the sand is added. This reduces the tendency of fines to remain in suspension. The sample should be poured in slowly to avoid entrained air. The small bucket is then hung on the balance, the water level adjusted so it is just submerged, and enough sand added through the tube to balance the 1,000-gram weight.

The sand in the small bucket is then dried, weighed, and the weight of absorbed water determined. The sum of these two weights is a constant which is used later to determine the amount of free moisture in any other sample.

The amount of free water present in any other sample of damp sand of which the weight in air is known, and similarly weighed submerged, is the weight of the damp sample in air minus the constant previously determined. This is because the free water present on sand ceases to have any effect when the sample is weighed submerged.

Part of our procedure is to weigh exactly 2,000 grams of sand into a pan. The amount remaining after sufficient has been used, when weighed submerged, to balance the 1,000 gram weight, give us the weight in air of the part used.

The accuracy of the determination may be checked approximately by drying any sample. The dry weight should be the same as that of the first sample.

This method is as simple and rapid as any in use. It has the advantage that no special, expensive, or fragile apparatus is required, and that no charts or calculations are needed. It is accurate within the limits necessary, as it takes absorption into account. Time is saved and errors avoided by using proportion instead of percentages. The free moisture in the batch is in direct proportion to that in the small sample. If weight proportioning is used the weight of the batch is known; if volume proportioning is used, a close approximation can be made by weighing the amount of sand (or coarse aggregate) required to fill the 10-qt. bucket, which has a volume of ⅓ cu.ft.

Cleveland, Ohio, May 3, 1929.

H. C. McCall,
Chief Engineer,
Concrete Engineering Service Company.

Tallest Reinforced Concrete Building in 1928

Sir—I have noticed that in your editorial survey of the issue of February 7 you refer to a twenty-one story, 235-ft. apartment building in Chicago as being the tallest reinforced concrete structure built during the year. It is not clear from the context whether "tallest" refers to the United States only, or to the construction field generally. From references under some of the other headings in the survey, infer that

254-FT. STERLING TOWER, TORONTO

the intention was to cover the outstanding structures of an engineering nature throughout the world.

There was built in Toronto, Ontario, during the year 1928 a reinforced concrete building somewhat taller than the Chicago apartment house referred to. This was the Sterling Tower which is an office building twenty-one storys and 254 ft. in height above the sidewalk. The building is 63x90 ft. in plan dimensions, and is constructed entirely of reinforced concrete with the exception that six of the twenty-four columns have structual steel cores in the ground floor and basement. The building is shown in the accompanying photograph.

Toronto, Ont., Canada.

J. Morrow Oxley,
Chapman & Oxley.

News of the Week

World Power Conference Meets

Thirty-two countries will be represented at the sectional meeting of the World Power Conference to be held in Barcelona, Spain, May 15-23. Among the matters to be considered at this conference are the following: importance and order of preference in the utilization of water power resources; influence of hydrological characteristics in different countries; provision for flood and low waters; general control of rivers; civil engineering work; shut-off, discharge and water-level control devices; automatic devices; constructions in selenite soils; study of agglomerates, proportioning their ingredients and determining the mixtures; influence of the resistance, duration and impermeability of the works; profitableness of utilizing water power for the production of energy in different countries; the most suitable way of increasing consumption; and economic relation between industrial and agricultural utilization.

Sale of Kentucky Bond Assures Toll Bridge Construction

The State of Kentucky on May 7 completed the sale of approximately $10,767,000 in bridge bonds, thus making possible a program of construction on toll bridges throughout the state. From the proceeds of the bonds, the commission will erect bridges over the Cumberland River at Burnside, Canton, and Smithland; the south fork of the Cumberland at Burnside; the Kentucky River at Tyrone and Boonesboro; the Ohio River at Carrollton, Evansville and Maysville; the Tennessee River at Clark's River, Eggner's Ferry, and the Green River at Spotsville. The total estimated cost of these structures is $10,279,000. Revenue from the bridges will be used to pay interest on the bonds and retire them, after which the bridges will be perpetually free.

New York Sewage Works Association Organized May 4

The New York State Sewage Works Association was organized at Albany on May 4. Of 83 who had applied for membership, 22 were present at the meeting. The following officers were elected: President, Kenneth Allen, sanitary engineer, Board of Estimate and Apportionment, New York City; vice-president, C. A. Holmquist, director, Division of Sanitation, State Department of Health, Albany, N. Y.; secretary-treasurer, A. S. Bedell, assistant engineer, New York State Board of Health. The association proposes to hold a meeting in Rochester in the latter part of July of this year.

Lockout in N. Y. City Building Trades Stayed by Supreme Court Order

Over $150,000,000 in Building Projects Affected — Five Day Week Cancelled

APPROXIMATELY 1,200 members of the Building Trades Employers' Association of New York City, through their representatives, voted unanimously May 13 to declare a lockout affecting about 75,000 union workmen, to go into effect at 5 p.m. May 15. Execution of the decision was temporarily postponed when the workers, acting through the United Cement and Concrete Workers Local No. 20, secured from Supreme Court Justice Gavegan a temporary injunction staying action until May 17, when a hearing is scheduled to determine whether or not the injunction should be made permanent.

The trouble started when three members of the Electrical Contractors' Association refused to join the Building Trade Employers' Association in granting the five-day week, and accordingly hired a number of non-union men. As a result, union men employed by these firms declared a strike, soon followed by sympathetic strikes of other building crafts. The matter was taken up by the Building Trades Council, which demanded that the employers' organization expel the three electrical contractors concerned. The employers retaliated by declaring the lockout.

At the same time the employers rescinded their action taken May 4 granting to 150,000 building trades mechanics the five day week, with a 10 per cent increase in wages. They stated that the agreement by which the five-day week was granted included the adjustment of difficulties between electrical contractors and workmen, which have nevertheless continued. This is denied by the unions.

The employers further maintain that the unions restrict output, attempt to dictate to whom contracts should be awarded, demand cancellation of contractors' contracts with non-union fixture manufacturers, and have destroyed the morale of men working for certain contractors by means of heavy fines for trivial offenses.

The trades included in the lockout include the following: carpenters, derrickmen, steamfitters, sheet metal workers, cement and concrete workers, bronze workers, composition roofers, metallic lathers, plumbers and electricians. It is estimated that the lockout would affect present construction to a value of $150,000,000, including the new Chrysler, Lincoln and Daily News buildings.

Automatic Train Stops Approved on Two Railroads

Installations of automatic train stop devices on sections of the Pennsylvania and Erie Railroads has been approved by a division of the Interstate Commerce Commission. On the Pennsylvania, a continuous induction type of code system has been installed between Baltimore, Md., and Lemoyne, Pa., a distance of 81.5 miles, at a reported cost of $1,557,281. The Erie installation is of the intermittent induction type on 141 miles of double track between Susquehanna and Hornell, N. Y. The reported cost is $169,238.

Utah Appropriates $1,135,000 for Building Construction

The Utah Legislature has made the following appropriations for buildings which will be constructed within the next two years: Engineering building, University of Utah, $100,000; completion of Kingsbury Hall, University of Utah, $175,000; laboratory, $10,000; for the Agricultural College, Logan, library, $175,000; clinic, $10,000; and the repair of old buildings $15,000; Utah State Hospital, Provo, $175,000; building for Ogden School for Deaf and Blind, $50,000; dormitory for State Industrial School, $125,000; and School for Feeble Minded, $300,000. The bill provides that all this construction shall be done by contract.

New Jersey Asks Leave to File Suits Against New York City

The State of New Jersey filed an application with the United States Supreme Court on May 13 for a permit to bring a suit against the city of New York to restrain it from "nuisance causing damage to the property of the plaintiff and its citizens and a menace to the health of its inhabitants by dumping garbage and refuse in the Atlantic Ocean off the coast of the plaintiff"; also for permit to file a suit to enjoin "the threatened diversion within the State of New York of waters of five tributaries of the Delaware River" for the water supply of New York City—specifically diversion from the Neversink River, Willowemoc River, Beaverkill, East Branch of the Delaware River and the Little Delaware River, on each of which the city of New York proposes to build impounding reservoirs for the storage of flood waters. The New Jersey complaint maintains that there is no public necessity for the proposed diversion of the tributaries of the Delaware for the benefit of New York City and that part or all of the water is to be used for the development of hydroelectric power.

20-Story Medical Arts Building for Louisville

Plans for a twenty-story $3,500,000, Medical Arts Building in Louisville, Ky., are being rushed to completion following the selection of a site by the joint building committee of the Jefferson County Medical Society and the Louisville District Dental Society. The building will be L-shaped and contain about 230,000 sq.ft. of floor space, according to reports. It will be the tallest structure in Louisville. Space in the basement and on the first five floors is to be set aside for a garage. The architects are Holabird & Root, Chicago, and the structure is being financed by the George A. Fuller Company, of New York City.

Fifty Papers on Many Topics on A.W.W.A. Toronto Program

Fifty papers appear on the preliminary program for the convention of the American Water Works Association at Toronto, Ont., June 24-29. There will be an informal reception Monday evening; the water purification division will have a dinner Tuesday evening and on Thursday evening there will be a dinner dance. No excursions and no committee reports are scheduled, but Committee 19, Boiler Feed Water Studies, will hold two open conferences, each parallel with a general session.

Nearly half of the papers will be on either water purification or feed water treatment, including several on water softening, mostly by zealites. For those interested in pumping station design and operation there will be a general session, with four papers at the same time as one of the boiler feed conferences.

The plant management and operation division will hold three sessions, two with superintendents' round tables. One of the general sessions will be devoted to large-size pipe lines, opening with a description by Allen Hazen, of the welded steel conduit at Springfield, Mass., followed by a discussion on electric welded pipe in general, led by Samuel Martin, of the General Electric Company. "Notes on European Pipe Practice" will be presented by R. H. Keays, chief engineer, Ulen and Company, Athens, Greece. At another general session, Nicholas S. Hill, Jr., will read a paper on "Ethics for Engineering Services."

The usual exhibit will be held by the Water Works Manufacturers' Association. A special train will be run from New York to Chicago, over the Lehigh Valley and Canadian National Railways, leaving Penn Station, Sunday, June 23, 6:25 p.m., daylight saving time, and stopping at leading points en route. Fare and a half for the round trip will be available on the certificate plan.

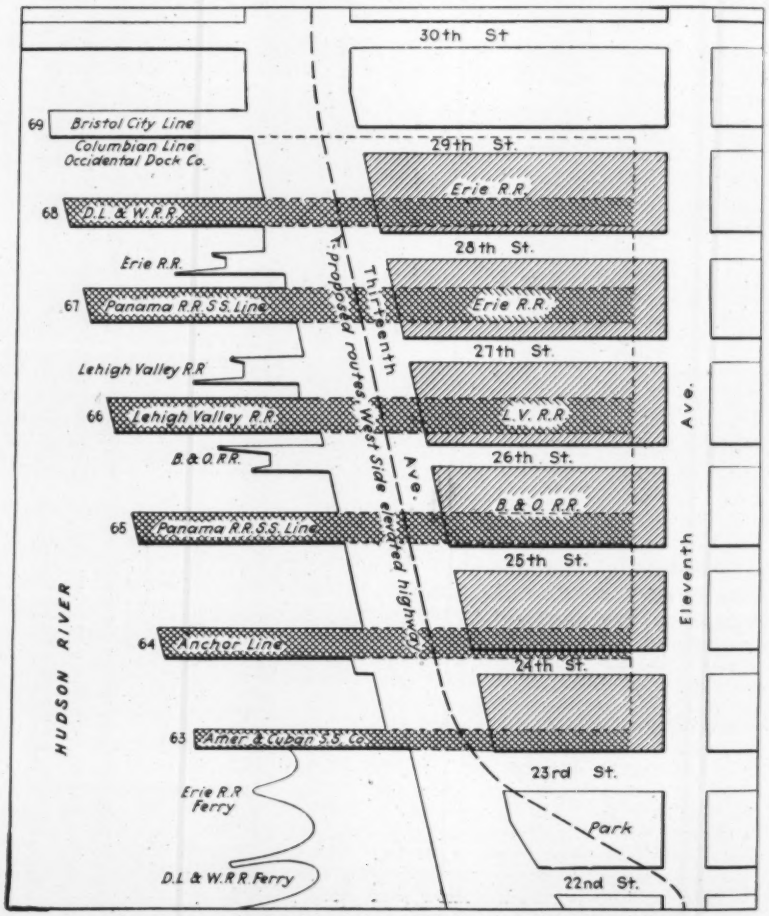
Further details of the convention and the special train may be had from the American Water Works Association, 29 W. 39th St., New York City.

Pier Extension Inland Proposed by New York City

Although the War Department has not yet acted upon New York City's application for permission to build 1,000-ft. piers at 48th and 50th Sts. for the accommodation of large transatlantic steamships, the city's Department of Docks has prepared an alternative scheme for use should the application be refused. This plan, which involves a cost of between $23,000,000 and $24,000,000, involves the purchase by the city of six blocks of property between 23rd and 29th Sts., extending from the west side of Eleventh Ave. to the Hudson River, and the extension of the piers inland from the established pier-head line. As shown by the accompanying map, this will give pier lengths varying from 1,100 to 1,400 ft. The property involved is at present used chiefly for railroad yards and warehouses. It is stated that no objections will be raised by the railroad or steamship lines concerned, provided the city supplies similar accommodations.

The largest vessel now docking in New York is the "Majestic" of the White Star Line, with a length of 915 ft. overall. Two new liners are now under construction in Germany which will exceed the "Majestic" in length by 23 ft. In addition, a number of other large vessels are now in contemplation by other lines. It is feared that unless suitable piers can be provided for these boats in New York City, the steamship lines will procure docking facilities at some other port. A number of solutions have been suggested, including the lengthening of piers at 48th and 50th Sts., permission for which has already been applied for; the extension of these same piers inland, difficult and expensive because of the rocky nature of the land; the construction of diagonal piers to secure greater length without change in the present pierhead line, objected to because of the necessary reduction in the number of piers for the same waterfront area; and the staggering of piers on the New York and New Jersey side of the Hudson, which will preserve the same width of channel as at present, but will introduce greater curvature.

The tentative route for the West Side elevated highway between 23rd and 29th Sts. follows Thirteenth Ave., as is shown by the plan. Should it be decided to use this area for piers, it will be necessary to change the location of the highway, the contract for which has not yet been let, to Eleventh Ave., returning to the waterfront in the vicinity of 30th St. As it is planned to let the contract for this section of the highway in the near future, the present plan was worked out by the Department of Docks of New York City so that the two projects may be properly co-ordinated.



LOCATION OF PROPOSED PIER EXTENSIONS IN NEW YORK

California Railroad Commission Creates Safety Division

Effective May 1 a new division of the California Railroad Commission's engineering department, to be known as the safety division, has been created for the express purpose of promoting safety of operation of transportation utilities.

The safety division will investigate serious accidents such as train collisions, derailments, and stage and truck accidents. It will study means of preventing all forms of accidents, the deduction of fire hazards on common carriers, and the elimination of clearance hazards, and also all matters relating to railroad signalling, interlocking, train control and kindred matters.

The safety division will be in charge of H. L. Engelhardt, with the title of safety engineer. Mr. Engelhardt has had many years' experience in safety work, and during his two years' employment with the commission has devoted his entire effort to that class of work. He will be assisted by three safety inspectors, W. F. Lemon, H. C. Lemon and A. S. Meininger.

In its announcement the railroad commission states that it believes the organization of a special corps of trained men, whose sole responsibilities will be the study of safety measures, will enable the commission to serve the public even more adequately than before in this important respect. Through the new safety division it will continue to cooperate to the fullest extent possible with other public agencies, such as Industrial Accident Commission and the Interstate Commerce Commission, in the promotion of safety of transportation operation in California.

Committee Reports Feature of Road Builders' Meeting

Plans for studies benefiting the highway industry were furthered at the annual meeting of the American Road Builders' Association held May 2 and 3 in Washington. A committee is preparing questionnaires for the standardization of road building equipment. These will be sent to the highway commissions in every state asking for recommendations and information on existing laws and practice. The depreciation of construction and maintenance equipment for bituminous surfaces is also to be studied. Graphs and straight line methods are being developed for calculating depreciation for various highway purposes.

The finance committee is investigating the standardization of auto license fees and equitable methods for collecting the gasoline tax. A study is being made as the use of gasoline tax money for other than highway purposes.

Another committee is carrying on research with respect to liens in public construction. This year's work is a compilation of liens as affecting construction in every state of the union. Data for 25 states are now complete. A report probably will be published first as a survey and submitted to government officials and others before recommendations are made. A new committee was appointed to start a survey of national, state, county, and local legislation.

Major D. A. Davison of the Corps of Engineers was appointed chairman of a committee to study types of surfacing for airports, concerning which subject little is yet known.

The new president of the association is F. A. Reimer, consulting engineer, of Orange, N. J., who succeeds R. Keith Compton of Richmond, Va. The two incoming directors are A. W. Dean, chief engineer of the Massachusetts State Highway Commission, and J. S. Helm, president of the Asphalt Association and general manager of the Asphalt Sales Department of the Standard Oil Company of New Jersey.

It was announced that the annual convention will be held in Atlantic City, N. J., Jan. 11-18, 1930. This city, it is stated, is one of the few with facilities to accommodate the 30,000 people and 500 carloads of machinery and equipment normally assembled.

New Western Rail Line Approved

Authorization has been given by the Interstate Commerce Commission for the construction of a new railway line 71.45 miles in length from Coburn to Birmingham, Mo., by the St. Paul & Kansas City Short Line Railroad, a subsidiary of the Chicago, Rock Island & Pacific Railway Company. The order also gives the Short Line permission to operate under trackage rights over the Rock Island from Allerton to Coburn, Mo.

The purpose of the proposed line is to provide the Rock Island with a more suitable and economical route from Minneapolis to Kansas City and the Southwest. At present the Rock Island operates over the tracks of the Chicago, Burlington & Quincy Railroad for a distance of 51.74 miles between Cameron Junction and Harlem, Mo., under the terms of a trackage agreement which terminates Dec. 31, 1929. The proposed line will save 9 miles in distance and reduce the ruling grade from 1.4 per cent to 0.5 per cent in both directions. It is proposed to construct the new track of 100-lb. second-hand rail at an estimated most of $11,472,658. Construction is to begin in the near future, and it is expected that the line will be ready for operation by Dec. 31, 1930.

North Dakota Unifies Control of Highway Department

Elimination of the condition of divided authority under the North Dakota Highway Commission has been secured by the virtual abolishment of the office of secretary, and by transferring the duties of secretary, who has been the chief administrative officer, to the chief engineer, H. C. Frahm. J. J. Ermatinger, who has been secretary of the commission for the past two years, has severed his connection with that organization to reengage in the practice of law.

Oklahoma Water Conference to Take in Sewage-Works

At the fifth Oklahoma Water Works Short Course, recently held at Stillwater under the joint auspices of the Oklahoma Water Works Conference, the Oklahoma A. & M. College, the Oklahoma State Board of Health, and the Oklahoma Department of Vocational Education, the conference resolved to change its name to the Oklahoma Water Works and Sewage Conference and to become affiliated with the Federation of Sewage Works Associations. It was voted to request the legislature to provide sufficient funds to permit enlargement and furthering of the aims and work of the organization.

New officers were elected as follows: President, C. K. Bullen, Stillwater; vice-president, Fred Cowell, Lawton. A two days' inspection tour of nearby water and sewage-works was made.

Taking into account the fact that a majority of the water supplies of Oklahoma are received from wells, there was a series of papers on well construction, pumping, operation and maintenance, by H. J. Darcey, state sanitary engineer, and others. The need of sewage research was urged by V. H. Ehlers, state sanitary engineer of Texas. Algae control was taken up by James Barron, engineer, Kansas State Department of Health.

Highway Officials Name Western Committee on Materials

T. E. Stanton, material and research engineer of the division of highways, Department of Public Works, of the State of California, has been appointed chairman of the newly created western section of the committee on materials, American Association of State Highway Officials. Other members of the committee are: N. M. Finkbiner, engineer of materials, State Highway Commission, Salem, Ore.; Raymond Harsch materials engineer, Bureau of Highways, Boise, Idaho; Levi Muir, Jr., materials engineer, State Road Commission, Salt Lake City, Utah.

Airports Competition for the Design of a Modern Airport

Recent announcement has been made of a modern airport design competition which has been planned on the most comprehensive and practical lines possible. To make certain that no measure of commercial interest would be injected into the competition the sponsor, the Lehigh Portland Cement Company of Allentown, Pa., has turned over its entire control to independent competition managers, Taylor, Rogers & Bliss, Inc., 40 East 49th St., New York City. In addition a program committee headed by Harvey Wiley Corbet and Francis Keally, New York architects of note, established the competition requirements in a manner designed best to serve the interests of architects, engineers, city planners, civic organizations and the aeronautics industry. In the announce-

ment it is stated that "This competition is designed to present to the public designs of practical as well as inspirational value to guide the development of airports, present and future."

Judgment of the competition entries will be based on the excellency of design, practicability from engineering, architectural and aeronautical viewpoints and the ingenuity displayed in developing both the structures and their relationship to the landing area to meet economically the air traffic problems of today and the future. First, second, third and fourth prizes are respectively $5,000, $2,500, $1,000 and $500. Ten honorable mention prizes of $100 each also will be awarded. Complete information on the conditions of the competition may be obtained from the competition managers.

South to Have $35,000,000 Gas Pipe Line

The Southern Natural Gas Corporation has entered into a contract with Ford, Bacon & Davis, Inc., for the construction of a natural gas pipe line extending from the Monroe and Richland gas fields of Louisiana through Birmingham, Ala., to Atlanta, Ga., which will make available natural gas for domestic and industrial purposes to the territory surrounding these cities.

Twenty-year contracts have been entered into, which will assure a supply of natural gas for this line. An expenditure of about $35,000,000 is involved in this project. More than 1,400 miles of pipe will be laid. The line to Atlanta is to be completed by Dec. 31, 1929.

Place First Section of Detroit Vehicular Tunnel

The first section of the vehicular tunnel connecting Detroit with Windsor, Canada, was put into place May 3. This section, 220 ft. in length, is shorter than the others which will follow as soon as the river bed is prepared to receive them. The other nine sections will range in length from 248 to 250 ft. The tunnel is 33 ft. in diameter.

Permit Sought for Project at Priest Rapids, Wash.

Application has been filed by the Washington Irrigation and Development Company, Seattle, with the state hydraulics supervisor for permission to appropriate 50,000 sec.-ft. of water from the Columbia River in Grant and Yakima Counties, Wash. Plans call for the erection of a 90-ft. dam and the creation of a reservoir with a storage capacity of 140,000 acre-ft., which would inundate 5,715 acres of land. The power plant would house two units with total capacity of 450,000 hp. The first unit, which would be undertaken within the next two years provided the permit was obtained, would have an output of 200,000 hp. The total cost of the entire project is estimated at $41,242,000.

Brief News

A STEEL BRIDGE across the Ohio River, between Paducah, Ky., and Brookport, Ill., was opened May 8. The concrete and steel structure is 9,200 ft. long and 20 ft. in width, and was erected at a cost of approximately $2,000,000.

PENNSYLVANIA has put into effect a new state building code which substantially incorporates the standard specifications of the American Institute of Steel Construction, and will apply to all building in cities of the first class within the state.

HARBOR DEVELOPMENT PLANS which will make Oswego, N. Y., accessible for the large grain boats which will come into Lake Ontario through the new Welland Canal are now being drawn up, and will be presented to the U. S. War Department for approval within a few weeks.

THE DESIGN of the Foshay tower in Minneapolis, involving tapering sides, is the subject of a patent application now awaiting decision at the Patent Office in Washington. It is also understood that other patents are being asked for on the airplane beacon and electrical display utilized on the building, and on the method of installing heating coils in the roof to eliminate accumulations of snow and ice. The design of the Foshay tower was described in *Engineering News-Record*, March 7, 1929, p. 372.

WAR DEPARTMENT APPROVAL has been secured by the Port Huron-Sarnia International Bridge Company for construction of a bridge across the St. Clair River north of Detroit at the southern tip of Lake Huron. As planned the structure will be approximately 1 mile long, with 2,300 ft. of its length over water and its vertical clearance at the center 152 ft. The cost will be approximately $4,000,000.

A CITY PLANNING Act passed by the last session of the legislature of North Dakota permits all cities of that state to levy a one-mill tax for planning purposes and gives the cities a certain amount of jurisdiction for three miles outside of their limits.

A SECOND ENGINEERING TOUR to Europe, under the direction of the University of North Carolina in cooperation with Rutgers University, will be conducted this summer. The members of the party will leave New York on July 3 and return Aug. 23. Instruction will be given in industrial administration and in labor management. Establishments in England, Holland, Germany, Switzerland and France will be visited. Special attention will be paid to the problems of personnel and to the organization of labor in the various countries visited. American and European methods and technique will be compared and the members of the party will have the opportunity of examining and comparing foreign practices and processes.

Find Breaks in Detroit Cables

Dismantling work on the Ambassador suspension bridge at Detroit has brought to light numerous broken cable wires located beneath the cable wrapping at the points of suspender connections. At the present stage of the work only the outside of the cables can be examined and it is in the outer layer of wires that the above breaks are located. The cable wire in this structure and on the smaller Mt. Hope bridge, near Providence, R. I., proved defective and was ordered removed (*Engineering News-Record*, April 4, 1929, p. 564). Although the maximum load placed on the Mt. Hope cables was three times that at Detroit, no breaks at the suspender connections have been found on the former structure. It has been suggested that the use of an erection traveler operating on the deck of the Detroit structure may have caused high localized stresses at the suspenders. At Mt. Hope a deck traveler was not used, erection being accomplished by a light frame traveler operating on the cables themselves.

42,500 H.P. Hydro-Electric Unit Ordered

Contracts involving $690,000 for the first 42,500-hp. generating unit of the Ruskin hydro-electric power plant have been awarded by the British Columbia Electric Railway Company. Construction of the hydraulic turbine was awarded to the Dominion Engineering Works, Ltd., and will be completed at that company's Montreal plant. The generator will be manufactured by the Canadian Westinghouse Company at Hamilton, Ontario. Four step-up transformers will be built at the Canadian General Electric Company's plant at Toronto. The machinery is scheduled to be completed and installed by the fall of 1930.

Utah Asks U. S. Survey of Upper Colorado Basin

Following its ratification of the Colorado River agreement, the Utah Legislature passed a resolution requesting that the Interior Department undertake a survey and classification of lands in the upper Colorado basin. In a letter of transmittal to Ray Lyman Wilbur, Secretary of Interior, Gov. George H. Dern of Utah said:

"It is obvious that the states of the upper Colorado basin will have to negotiate a compact to divide the water allotted to them by the Colorado River compact. I understand Congress has already passed a measure authorizing such compacts between Colorado and her neighboring states. From my study of the question I am satisfied that no satisfactory four-state agreement can be reached in advance of a careful study of the agricultural and power potentialities of the respective states." This would avoid an unfortunate quarrel such has existed between Arizona and Cali-

fornia for the past several years, Governor Dern declared.

The proposed survey is for the purpose of allocating the 7,500,000 acre-ft. provided in the compact between Wyoming, Utah, Colorado and New Mexico.

If an agreement could be worked out with California in regard to the revenue from power, the water situation, in the opinion of Representative Douglas, of Arizona, could be worked out without great difficulty. Mr. Douglas takes vigorous exception to the statement that Arizona would tax to death any power plant unless it were built by some agency of the federal government. Arizona, he says, is interested in securing revenue from one of the state's great resources. He regards the fall of the Colorado River as a resource just as much as are the mineral deposits of the state. The state, he declares, is not following a destructive policy, but simply is striving to prevent the withdrawal of a resource that should be an important source of state revenue.

Maryland Road Board Sues to Recover Stolen Funds

As an outgrowth of the recent scandal among employees of the Maryland State Roads Commission and other persons by which the state lost $376,000, the commission has filed a suit to recover $271,791.56 from the Union Trust Company of Baltimore. It is alleged that the trust company paid out this amount on 4,952 forged checks during the period from Oct. 1, 1920, to March 31, 1928.

Traffic Through Holland Tunnel Sets New Record

An increase in the total number of vehicles using the Holland Tunnel between New York and New Jersey in a single day was recorded on Sunday, May 12, when 52,184 vehicles used the twin tubes. This is the first time that the record figure of 51,648, set on the opening day, Nov. 13, 1927, has been surpassed.

High Water in Great Lakes Shown by Canadian Records

Water levels of the Great Lakes for the month of April, 1929, according to information supplied to *Engineering News-Record* by F. Anderson, hydrographer, Canadian Hydrographic Service, Ottawa, Ont., "averaged 9¼ in. higher than their mean level for April since 1860, and 19 in. higher than their mean level for April for the last 10 years." Taking up next the mean levels by each of the lakes, except Michigan, the *Monthly Bulletin* of the Precise Levels Division of the Canadian Hydrographic Service states:

Lake Superior for April, 0.09 ft. higher than March; 0.73 ft. higher than April, 1928; 2.46 ft. higher than April, 1926—the lowest April on record; 0.24 ft. lower than April, 1860—the highest April on record.

Lake Huron for April, 0.66 ft. higher than March; 1.83 ft. higher than April, 1928; 3.49 ft. higher than April, 1926—the lowest April on record; 1.91 ft. lower than April, 1886—the highest April on record.

Lake Erie for April, 0.93 ft. higher than March; 1.60 ft. higher than April, 1928; 2.61 ft. higher than April, 1926—the lowest April on record; 0.96 ft. lower than April, 1876—the highest April on record.

Lake Ontario for April, 1.13 ft. higher than March; 0.87 ft. higher than April, 1928; 2.56 ft. higher than April, 1895—the lowest April on record; 1.12 ft. lower than April, 1886—the highest April on record.

Albany Awards Pipe Contract

Cast-iron pipe for the new water supply system of Albany, N. Y., will be supplied by the United States Cast Iron Pipe Company, Burlington, N. J., under the terms of a contract amounting to $1,457,312 recently awarded by the city. At the same time a contract for laying pipe on the basis of leadite joints was awarded to Popper Bros., Syracuse, N. Y., for $793,593.

To Dedicate Lee's Ferry Bridge

Formal dedication of the Lee's Ferry bridge across the Colorado River between Arizona and Utah will take place June 14 and 15. The structure, which was described in *Engineering News-Record*, Nov. 1, 1928, pp. 646-649, is a steel arch span 616 ft. long and is 467 ft. above the river level. Material was hauled a distance of 130 miles from the nearest railway point.

WASHINGTON NOTES

By Paul Wooton
Washington Correspondent

Urge Second Review of Flood Control Plans—Request U. S. Aid for New Orleans Bridge

AN OFFICIAL COMMITTEE of Senators and Representatives from the Mississippi Valley is urging the President to review the report made to former President Coolidge by the board of review which was set up by the flood control act. President Coolidge approved all of that report except the part dealing with payment for property rights. This he left open for his successor to deal with as he sees fit. The Senators and Representatives, after a conference with the President, are drawing up a memorandum setting forth their views and the arguments they offer to support them. This memorandum has not been completed at this writing, but it is understood that the position will be taken that the President should decide whether or not compensation is to be paid for the property rights involved. It will be held that this question must be settled before the engineering differences can be considered intelligently.

The committee of legislators feels that, since Mr. Coolidge was not definite in his approval of the report of the board of review, the whole report should be reopened and reexamined. The Senators and Representatives on the committee contend that the authority given the President to review the engineering differences is a continuing one and that he may request studies made at any time questions arise.

The memorandum for the President, among other things, is expected to contain the following:

In the Boeuf basin the Jadwin plan provides for the withdrawal of 900,000 sec.-ft. to be carried in a floodway from the vicinity of Arkansas City to the Red River, at a total estimated cost of $7,700,000. This floodway would be thirteen miles wide and 150 miles long, covering an area of 2,525,000 acres, on which 70,000 people now reside. The area is traversed by railroads, highways and drainage canals.

The Mississippi River Commission plan for a floodway in the Boeuf basin provides for the diversion of 600,000 sec.-ft. over the same general territory as that traversed by the Jadwin floodway. The total estimated cost is $107,000,000, which includes compensation for property interests. This floodway would be five miles wide and cover 1,900,000 acres. The Jadwin plan applies to an area more than two and one-half times as wide. If that plan should be followed in the Boeuf basin, and if the government were required to pay for property rights, the cost, as a consequence, would be greatly in excess of the commission plan.

In the Atchafalaya basin the difference in the estimated cost is $22,500,000 in favor of the Jadwin plan, on the assumption that the government is not to pay for property rights. Taking such payments into consideration the Jadwin plan in the Atchafalaya also would cost many millions more than that of the commission.

Aid for New Orleans Bridge

Members of the New Orleans Public Belt Railroad Commission discussed last week with Thomas H. MacDonald, the chief of the Bureau of Public Roads, the possibilities of extending federal aid to the construction of the bridge which the commission plans to build over the Mississippi River at Twelve-Mile Point above New Orleans. The commission suggested that $6,000,000 of the $17,000,000 which the bridge is to cost be charged against the service to be rendered vehicular traffic. Mr. MacDonald took the position that this was a disproportionate amount of the cost to allot to the vehicular service. It was believed, however, that no difficulty will be experienced in reaching an agreement as to the division of the cost, but difficulties are presented in working out a plan that will meet with the approval of the Louisiana Highway Commission. There is no question that the bridge located as it is outside of the city limits of New Orleans, comes within the terms of the Oldfield amendment, which allows the use of federal-aid funds on bridges. Whatever federal money may be allotted to this bridge will be deducted from the total amount paid Louisiana. It is apparent that half of the amount allotted to the vehicular part of the bridge will be greater than the total annual aid expended by the entire state of Louisiana. Just how much of the total amount the state highway commission will be willing to allow to the bridge is problematical.

Engineering Societies

CALENDAR

ANNUAL MEETINGS

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; annual meeting, Atlantic City, N. J., June 24-28.

AMERICAN WATER WORKS ASSOCIATION, New York; annual meeting, Toronto, Canada, June 24-28.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; annual convention, Milwaukee, Wis., July 10-12.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; annual meeting, Mexico City, Aug. 26-28.

* * *

THE MID-SOUTH SECTION, American Society of Civil Engineers, was organized at a convention held in Memphis, Tenn., April 29 and 30. The section is composed of members of the parent society located at Arkansas, Southern Missouri, Southern Illinois, Western Kentucky, Tennessee, and Northern Mississippi. The convention was attended by Anson Marston, president, and George T. Seabury, secretary of the parent society. Officers of the new section were chosen as follows: President, L. L. Hidinger, Memphis; secretary, R. E. Warden, Little Rock; vice presidents and directors, N. B. Garver, Little Rock; Chas. W. Okey, Walnut Ridge, Ark.; J. H. Dorroh, Oxford, Miss.; J. C. H. Lee, Vicksburg, J. H. Haylow and F. V. Ragsdale, Memphis.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS will hold an aeronautic meeting in St. Louis, Mo., May 27-30, at which over 40 technical papers will be presented. A number of special events will be included on the program, including an airplane exhibit in which 125 American airplane manufacturers have been invited to participate.

THE MOHAWK VALLEY ENGINEERS CLUB, at a meeting May 8 in Utica, N. Y., elected the following officers: President, Joseph F. Lamprecht; vice-presidents, L. E. Warner, W. T. Conlon and B. T. Babbitt; secretary-treasurer, Walter F. Hudson. The annual outing of the club will be held at Three Islands on June 12.

THE NEW YORK STATE SECTION, American Water Works Association, at the annual convention in Elmira, N. Y., May 1 and 2 elected the following officers: President, William A. McCaffrey, superintendent, municipal water works, Oswego, N. Y.; secretary, Edward D. Case, New York City.

THE SMOKE PREVENTION ASSOCIATION is holding its 23rd annual convention at Kansas City, Mo., May 14-17. Its program includes the following papers: "Smoke Abatement from the Business Man's Viewpoint," Franklin Moore, Kansas City, Mo.; "The Smoke Situation in St. Louis," Osborn Monett, Citizens' Smoke Prevention Commission; "Smoke Abatement Practice at Detroit," Charles McCabe, chief smoke inspector; "Diesel Locomotive Practice," Chas. Longman, C. & N. W. Ry.; "Black Smoke and Its Prevention," J. E. Bjorkholm, assistant superintendent of motive power, C., M., St. P. & P. Ry.; "Locomotive Practice for Small Abatement," J. M. Nicholson, fuel conservation engineer, Santa Fe Ry.; "Direct Steaming of Locomotives at the Cincinnati Terminal of the Big Four Railway," F. V. Murphy, assistant superintendent of motive power.

THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS will hold its semi-annual meeting June 26-28 at Lake-of-Bays, Ontario, Canada.

Personal Notes

JAMES H. VAN WEGENEN has been appointed a member of the International Boundary Commission by President Hoover. He succeeds the late E. LESTER JONES. Mr. Van Wegenen has been an engineer with the commission since 1910.

RICHARD HAENICHEN, JR., has been appointed plan examiner and engineer in the building department of Paterson, N. J., subject to examination by the Civil Service Commission.

ERNEST S. ROSS, consulting highway engineer for the road department of the Nippon Oil Company, Tokyo, Japan, has resigned and is returning to the United States, arriving in Los Angeles May 19.

PAUL MORTON, who has been city manager of Alexandria, Va., since 1925, has resigned to become city manager of Petersburg, Va. He will assume his new duties July 1.

S. J. DALTON of Jackson, Miss., former engineer of the eighth district of the Mississippi State Highway Department, has been promoted to maintenance engineer to fill the vacancy caused when G. A. DRAPER succeeded H. C. DEITZER as state highway engineer. Dalton has been succeeded by W. D. McKENZIE of Hattiesburg, who had charge of the sixth district, while J. D. LEWIS of Columbus takes McKenzie's place at Hattiesburg.

J. EDSON HUDSON, supervisor from the town of Varick, N. Y., has been reappointed county superintendent of highways by the Board of Supervisors of Seneca county. Louis E. Mayer, of Seneca Falls, who stood first in the recent civil service test, declined the position. Another examination will be called to secure a list of three candidates from which the position will be filled permanently.

FRANCISCO GÓMEZ-PÉREZ, of Mexico City, who has been a member of the faculty of the college of engineering of the National University of Mexico, and has been connected with *Ingeniería*, its monthly publication, is now assistant to the consulting engineer at Rodriguez dam, the highest Ambursen type dam yet built, which is now under construction south of Tijuana, in the Northern District of Lower California, Mexico.

H. B. BARRY, for 23 years a member of the engineering department of the St. Louis-San Francisco Railway, has been promoted to the rank of assistant chief engineer. His headquarters will be in St. Louis. In the past few years Mr. Barry has been principal assistant engineer.

J. C. MCVEA, for the past ten years city engineer of Houston, Tex., has resigned and has opened offices in the Esperson Building, Houston, specializing in municipal improvement engineering.

H. L. SHAW, formerly city engineer of Corpus Christi, Tex., has been appointed city engineer of Houston, Tex., succeeding J. C. McVea, resigned.

TALCOTT MOORE, district engineer for the Wyoming Highway Department, who has been in charge of work in Fremont County, has resigned to accept a position with the state of Oregon. He will be succeeded by J. J. SMITH, resident engineer at Casper, Wyo.

Obituary

FRANK H. PECK, who for many years was a member of the pioneer Atlanta contracting firm of J. C. Peck & Son, died at his home in Atlanta, Ga., the early part of this month at the age of 72. A graduate of the Southern Medical College, Dr. Peck gave up the practice of medicine in the late seventies to join his father in the contracting business he had established in Atlanta shortly after the Civil War, and he remained actively identified with this company until his retirement from business life a few years ago. The company constructed many of the buildings that are today considered among Atlanta's landmarks, and made contracting history in the Southeast by erecting the Kimball House in 88 days' having accepted a contract to build the hotel in 90 days.

JOHN BAXTER ROGERS, 62, died recently at his home in Beverly Hills, Calif. Born in New York City, he had spent most of his life on the Pacific coast and in China and Europe, as consulting engineer on railroad construction projects. He served on the committee of reconstruction following the San Francisco earthquake and fire in 1906.

JAMES P. MAXWELL, who was state engineer of Colorado from 1885 to 1893, died at his home in Boulder, May 6, aged 90. He was the oldest living graduate of Appleton University, Appleton, Kan.

JOHN B. CARR, prominent contractor of LaGrange, Ga., where he has been identified with the building industry for several years, died May 6 at a sanitarium in Atlanta following an illness of about a week.

Construction Equipment and Materials

New England Holds Fifth Outdoor Road Show

The fifth annual construction equipment and materials show of the Massachusetts Highway Association was held May 7, 8 and 9 near Cottage Farms Bridge, Cambridge.

The outdoor feature enabled the exhibitors to operate equipment and tools under their own power and some eighty manufacturers and distributors took advantage of the opportunity to demonstrate their machinery somewhat under job conditions. Shovels, pumps, graders, compressors, tractors, loaders, mixers, trucks, etc., were put through their paces and gave the banks of the Charles River an air of unusual construction activity.

The show was well attended, continuing to grow in size and popularity.

Reinforcing Steel Institute Holds Annual Meeting

The fifth annual meeting of the Concrete Reinforcing Steel Institute, held at Asheville, North Carolina, April 15-17, is said to have been one of the most successful which the Institute has held. It was followed on April 18 by a trade practice conference, held under the auspices of the Federal Trade Commission. C. Louis Meyer, president of the Concrete Engineering Company, Omaha, was elected president of the Institute; O. W. Irwin, vice-president, Truscon Steel Company, Youngstown, Ohio was elected vice-president; and Hugh J. Baker, president of Hugh J. Baker & Company, Indianapolis, was re-elected treasurer. M. A. Beeman was re-appointed secretary and R. W. Johnson was re-appointed engineer.

It was voted to set up a new department of the Institute to deal with concrete ribbed floor construction. In the trade practice conference a number of rules covering the reinforcing steel fabricating and distributing industry were proposed, adopted and submitted to the Federal Trade Commission for its consideration. The Institute also agreed to assist financially in a series of tests to determine the properties of reinforced concrete columns, under the direction of the American Concrete Institute and with the co-operation of the Portland Cement Association and other interested organizations.

Business Notes

Novo Engine Company, Lansing, Mich., announces the appointment of the following distributors: Jersey Contractors Equipment Company, Plainfield, N. J.; Fitzgerald & Hudson, 150 Nassau St., New York City; Fred Lemcke, Jackson, Mich.; Wylie Bros. Inc., Tulsa, Okla.; R. L. McDonald, Inc., Springfield, Mo.; Anderson Tractor & Equipment Company, Biltmore, N. C.; Tennessee Tractor Company, Nashville, Tenn.; Mine & Smelter Equipment Company, Phoenix, Ariz.; Lund & Company, Salt Lake City, Utah, R. T. McClelland, Inc., Oakland, Calif., who have been distributors for several years are now operating under the firm name of Krantz-McClelland, Inc., 522 Bryant St., San Francisco, Calif.

Construction Equipment Company, Spokane, Wash., has been formed with the purchase by C. A. Burnette and associates of the contractors' equipment department of the Hofius-Ferris Equipment Company. Mr. Burnette has been associated with the contracting and contractors' equipment business for a considerable time and is a past president of the Associated General Contractors. He has been manager of the contractors' equipment department of the Hofius-Ferris Equipment Company for the past year.

The Triple Insulaire Company, Milwaukee, manufacturers of a recently developed insulation material made of corrugated wood fiber board in units 3 ft. long and of a suitable width to fit firmly between 16 or 24 inch studding centers, announces that W. G. Hollis, formerly secretary-manager of the Northwestern Lumbermen's Association and the Retail Lumbermen's Insurance Association, has become associated with the company as vice-president.

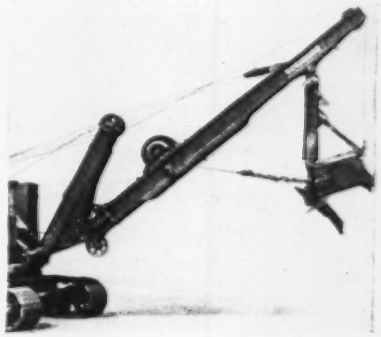
New Developments

New Pull Shovel Incorporates Shock Absorber Details

The latest unit added to the line of excavating equipment manufactured by the Koehring Company, Milwaukee, Wis., is a heavy-duty pull shovel available in two sizes equipped with ¾ and 1¼ cu.yd. dippers; the digging depths range from 17 to 24 feet. Unusual features incorporated in this equipment are the utilization of shock absorber details in the boom base and in the dipper stick and the use of a special jib frame claimed to provide a greatly increased working range and flexibility of operation.

The boom shock absorber is identical with that used on the company's other shovels. It is claimed to eliminate twisting strains in the boom and to cushion the dipper when it is used in such work as trimming the sides of a trench. The dipper stick shock absorber unit is said to add power to the digging effort exerted in hard, tough material by producing a gnawing action attributable to the powerful shock absorbing spring.

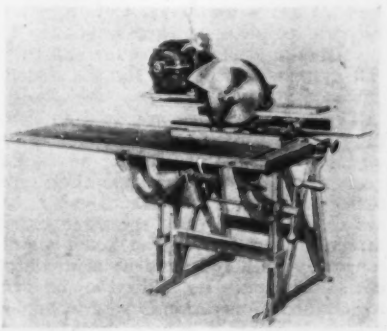
Instead of being hinged to the turntable casting, as is ordinarily done, the boom is hinged to a separate casting



which forms the base of the jib frame. The hinge point is 6 in., beyond the end of the crawlers which provides clearance for lowering the boom and dipper enabling the dipper to dig its full depth close up to the machine but with the ends of the crawlers resting on solid ground. The hinge point can also be raised about 2 ft., above the turntable hinge pin sockets, giving an exceptionally high dumping clearance. The dipper may be dumped either by tripping the dump door or by inverting the dipper. If necessary with sticky material the dipper can be jarred by striking the shock-absorbing spring-actuated lug on the dipper arm against the stop on the boom.

Saw Rig Adaptable to Many Classes of Work

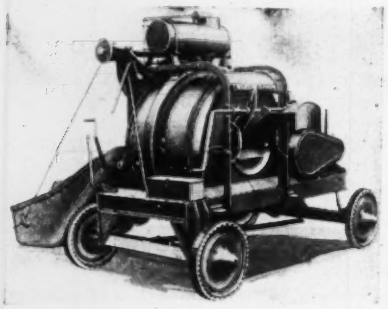
An improved model of its combination woodworking equipment has recently been announced by the Master Woodworker Manufacturing Company, Detroit, Mich. Some of the uses to which the rig is adaptable are: cross-cutting, ripping, jointing, routing, planing, boring, sanding, mitering, hand sawing, mortising, tenoning, grinding, and matching. The machine is equipped with ball bearings throughout and is made in five sizes electrically driven. One size is also adapted for gasoline engine drive.



An important feature of the rig is a wide table which tilts to allow bevel ripping. Another important feature is an overhead slide which travels easily on ball bearings on a machined way. With this the saw is pulled through the work which is claimed to give a saving of power over the old method of pushing the lumber against the saw. Adjustment of the depth of cut is made either by the table or by overhead screw and the wooden table is claimed to eliminate all danger of dulling the saws. The smallest model is powered with a ½-hp. motor, which weighs 175 lb., while the largest uses a 5-hp. motor and weighs 1,000 pounds.

A New One-Bag Mixer

A new 7-S mixer has been announced by the Construction Machinery Company, Waterloo, Iowa, as the Marsh-Capron Master 7. Speed in mixing and transportation are emphasized in the new model and at the same time sturdiness of construction has been given special attention. Some



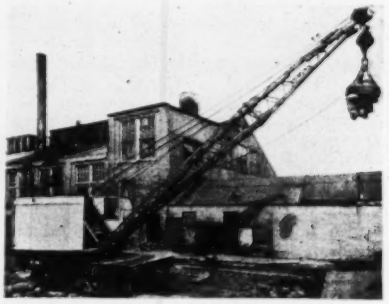
of the outstanding features are: Timken tapered roller bearings; spring mounted wheels to absorb shocks; rubber-tired or steel wheels which are interchangeable; diamond type roller chain drive fully inclosed and constantly lubricated by running in a bath of oil; and a patented water control tank. Like all Marsh-Capron mixers the rail tracks on which the drums revolve are guaranteed for the life of the mixer.

New Locomotive Cranes Utilize Gasoline Engine Power

Two new locomotive cranes with capacities of 15 and 20 tons built especially for gasoline engine operation, have been added to the products of the Thew Shovel Company, Lorain, Ohio. Electric or diesel power units can be furnished and plug-in, trolley and third rail systems can be had for the electric powered machines.

These new cranes are said to have all of the advantages of the steam crane and in addition to offer additional economies of one-man operation and lower fuel cost. The cranes can hoist, swing and travel (two speeds in either direction) or derrick the boom simultaneously with independent control for each operation. Its ability to perform simultaneous operation is said to be due to the company's center drive superstructure which transmits the full power of the motor to three shafts with clutch arrangement to permit engaging them separately or together.

The superstructures of the new cranes are the Lorain 60 and 75 super-



structures, transferred with minor changes from the two-speed center drive crawler mounting to a two-speed, eight-wheel, double truck body of ARA standard specifications. The 15-ton crane offers the flexibility feature of being readily transferable from car wheel to crawler mountings. The cranes are equipped with 45 or 50-ft. booms for use with 1 and 1¼-yd. clamshell buckets. Booms are in two sections with interchangeable boom heads and middle sections for various boom lengths. The eight-wheel double-truck car body is 24 ft. 2½ in. long over the couplers and is equipped with swivel outriggers and track clamps.

The car body has two travel speeds, 4.2 m.p.h. and 2.1 m.p.h. in either direction. Gear ratios can be varied to give other than standard speeds up to 14 m.p.h. for main line railroad work.

Construction, Labor and Material

Building Costs Slightly Higher

Building costs in percentages of 1913 costs stood 204 in April compared with 203.7 in March and 205.4 a year ago, according to American Appraisal index numbers. The average figures for the country are as follows:

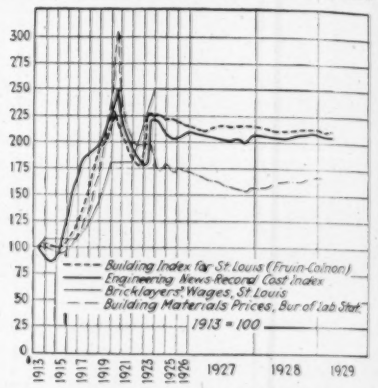
	April 1929	March 1929	April 1928
Frame	203.9	204.1	202.8
Brick (wood frame)	213.5	212.6	212.3
Brick (steel frame)	197.4	197.2	196.8
Concrete	201.0	200.8	199.6
Average	204.0	203.7	205.

The changes over the country may generally be regarded as negligible, though several tendencies are shown. Concrete building construction advanced everywhere except in the Pittsburgh district where there was a half point decline in cost, to the figure of a year ago. Frame costs advanced except in New York and the southeastern states. The same is true for brick with wood frame, except in the northwestern states and on the Pacific Coast. Brick with steel frame shows the greatest steadiness compared both with the month before and a year ago.

The Engineering News-Record Cost Index was 203.4 on April 1 and 205.15 on May 1 and 207 one year ago.

Building Costs in St. Louis

The Fruin-Colnon Index number of building costs for St. Louis, which was started in 1925 and published in the July 23 issue of *Engineering News-Record* of that year, has been brought to April 1, 1929, and is shown in the accompanying chart, together with general construction costs, building materials prices and labor rates. This index number is made up of actual and estimated costs of material and labor on a typical industrial plant consisting of five buildings of various types and materials. The close agreement in trend between this index and the *Engineering News-Record* Cost Index, com-



puted on an entirely different basis and for a different purpose, will be noted.

With respect to construction costs in St. Louis, it may be stated that wages are proportionately much higher than materials prices, as is quite generally the situation. Labor rates average 150 per cent above the 1913 level, while prices range from 20 to 80 per cent. Structural steel is 30 per cent higher than in 1913, cement 23 per cent, brick 75 per cent and lumber 77 per cent.

E. N.-R. Index Numbers

Cost			Volume		
May 1,	**1929**	**205.15**	**April,**	**1929**	**332**
Apr. 1,	1929	203.40	March,	1929	382
May 1,	1928	207.00	April,	1928	316
Average,	1928	206.78	Average,	1928	287
Average,	1927	206.24	Average,	1927	263
1913		100.00	1913		100

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of May 16, with some comparisons, total as follows:

(In Thousands of Dollars)

	May 16, 1929	May 9, 1929	May 17, 1928
Building:			
Industrial	$10,895	$35,645	$5,642
Commercial	73,111	33,117	46,840
Streets and roads	9,510	21,639	25,782
Other eng. constr.	46,091	16,886	15,524
Total	$139,607	$107,287	$93,788
Total, all classes, Jan. 1 to May 16:			
1929			$1,748,088
1928			1,326,639